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FOREHEARTH CONTROL AS APPLIED TO A HARTFORD-EMPIRE FEEDER

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Foxboro Company

IN THE manufacture of machine-made glass products one of the important and most difficult problems is the maintenance of absolutely uniform temperature in the glass feeder.

The viscosity of molten glass at the "pouring" temperature varies about one per cent for a one-degree Fahrenheit change in temperature. Any change in viscosity will affect the size of the gob of glass fed to the machine, which of course affects the weight and capacity of the finished product. Variation in temperature will also greatly affect the uniformity and quality of the finished product, due to subsequent changes in forming and annealing. The problem, then, is to control the temperature at which the stream of glass issues from the orifice of the feeder.

The molten glass in the tank is held at a higher temperature than the actual "pouring" temperature. It flows from the tank into the forehearth, and from there it is fed to the machine. The forehearth consists of two sections: the channel, which is really a conditioning chamber, and the spout. The glass flows from the tank under a skimmer block into the channel and from the channel under another skimmer block, into the spout. The channel and spout hold only a relatively small volume of glass so that its temperature may be quickly changed. The channel is equipped with adjustable louvers in the crown to cool the glass. It has two burners, one at each side, to maintain a uniform temperature throughout.

The spout, or feeder proper, has an orifice in the bottom center, as shown in Fig. 1, through which the glass is fed to the machine. Directly over this orifice is a constantly rotating plunger, whose function is to keep the glass in motion and thus maintain a uniform temperature. Any differences in the temperature of the glass at different parts of the spout will result in a "stratification," due to different viscosities, which will show up in the finished product.

This "stratification" is the principal reason that the more common forms of automatic temperature control, such as two-position and three-position control, have not proved successful on this application. There is a considerable lag in the glass temperature from the time an adjustment is made to the fuel input until the effect

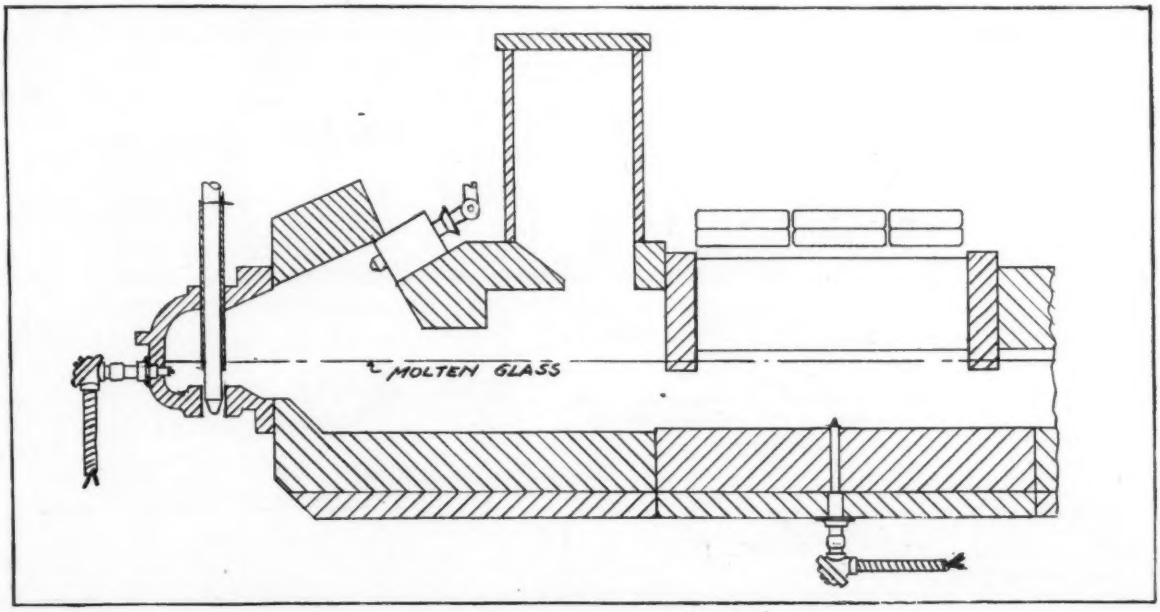


Fig. 1. Section of Glass Forehearth.

of that adjustment shows up at the thermocouple. And any of the "too much and too little" types of temperature control sets up a "cycling" of temperature, which in turn causes the temperature to vary in different parts of the feeder and results in the "stratification" of the finished product mentioned above. Further, the ordinary forms of so-called throttling control, either mechanical or electrical, are unsatisfactory on this application, because they cannot take care of changes in demand due to changes in load caused by shutdown for mold changes, etc., without manual readjustment. The controllers used in the installations referred to in this article have none of these disadvantages since they are full throttling control with throttling reset for change in demand. They have no "dead spots" and, when adjusted to the requirements of the feeder, cannot cycle.

In the two plants at which the experimental and development work on the feeder control system described here was done, the forehearths were oil-fired, using a float tank in the oil supply, similar in principle to a gasoline carburetor. The air supply to the burner was piped to the float tank, and thus at all times the oil pressure at the burner was maintained at exactly the same pressure as the air supply. A needle valve in the oil line, between the tank and the burner, made it possible, when once properly adjusted for correct combustion, to control temperature and combustion conditions by controlling the air supply only to the burner, as the oil pressure at the burner would vary in proportion to the air pressure. At the beginning, control was tried by maintaining only a constant combustion chamber temperature in the spout, with the idea in mind that the small volume of glass in the feeder would be directly affected by the combustion chamber temperature. This was not satisfactory; due, primarily, to the poor heat conductivity of the glass.

After several tests it was found that results could be obtained only by measuring the actual temperature of the molten glass. This was done by inserting a bare platinum rhodium thermocouple in the glass through the side of the feeder below the glass line (up through the bottom, in the case of the channel), as in Fig. 1. Figs. 2 and 3 show spout and channel thermocouple assembly.

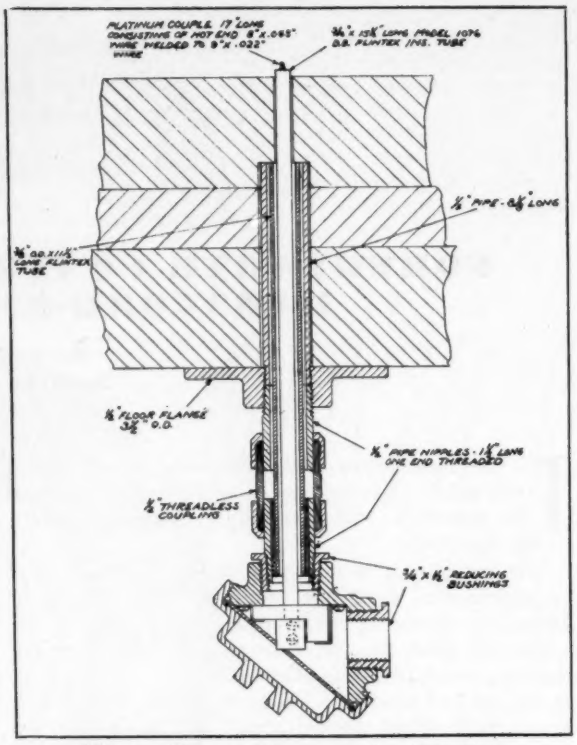

PLATINUM COUPLE 17" LONG CONSISTING OF HOT END 6" x .045" WIRE WELDED TO 9" x .032" WIRE
¾" x 12½" LONG, MODEL 1074 D.B. FLINTEX INS. TUBE
½" PIPE - 6½" LONG
¾" OD x 11½" LONG FLINTEX TUBE
½" FLOOR FLANGE 3½" O.D.
½" PIPE NIPPLES - 1½" LONG ONE END THREADED
½" THREADLESS COUPLING
¾" x ½" REDUCING BUSHINGS

Fig. 2. Channel Thermocouple Assembly.

The next step in developing the feeder temperature control system was to control the temperature of the spout by means of a Potentiometer Stabilog. Its thermocouple was inserted in the molten glass, and by directly operating a pneumatic valve in the air supply line to the burner, considerable improvement resulted. Under perfect conditions (never possible) of absolutely constant air and fuel pressures, and an absolutely frictionless valve (having perfect flow characteristics so that per-

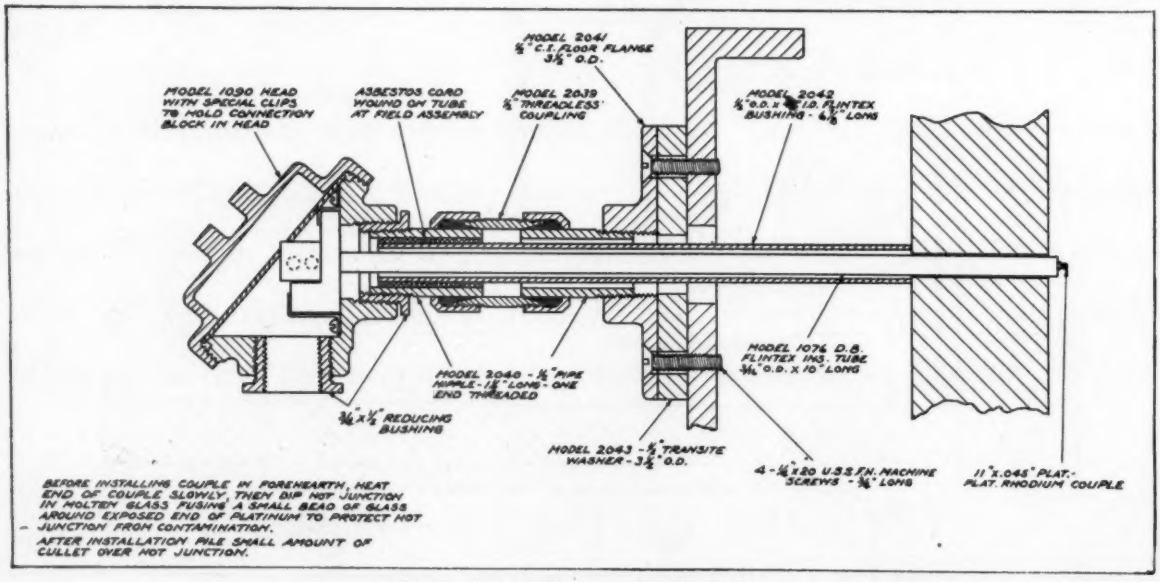
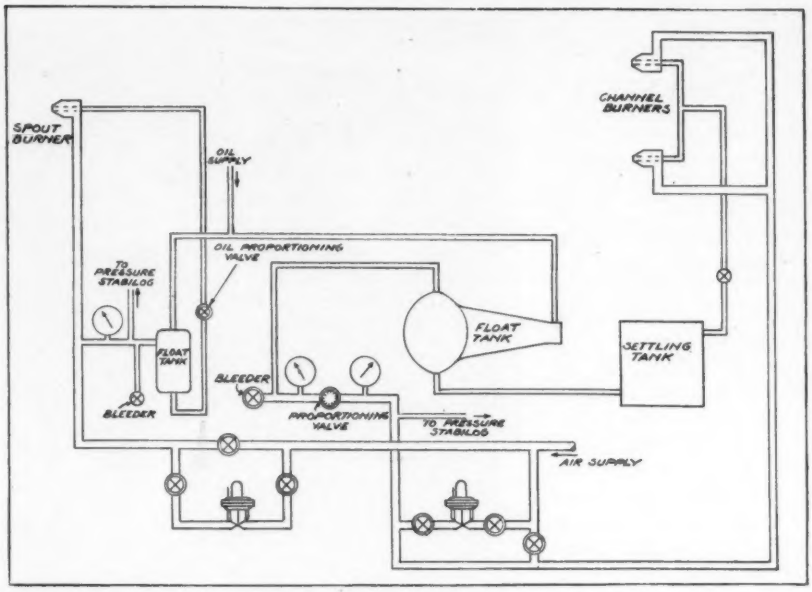

MODEL 2041 ½" C.I. FLOOR FLANGE 3½" O.D.
MODEL 1090 HEAD WITH SPECIAL CLIPS TO HOLD CONNECTION BLOCK IN HEAD
ASBESTOS CORD WOUND ON TUBE AT FIELD ASSEMBLY
MODEL 2039 ½" THREADLESS COUPLING
MODEL 2042 ½" O.D. x ⅜" I.D. FLINTEX BUSHING - 4⅛" LONG
MODEL 2040 - ½" PIPE NIPPLE - 1½" LONG - ONE END THREADED
¾" x ½" REDUCING BUSHING
MODEL 1074 D.B. FLINTEX INS. TUBE ¾" O.D. X 10" LONG
MODEL 2043 - ½" TRANSITE WASHER - 3½" O.D.
4 - ¼" x 20 U.S.S. F.H. MACHINE SCREWS - ¾" LONG
11" x .045" PLAT.-PLAT. RHODIUM COUPLE
BEFORE INSTALLING COUPLE IN FOREHEARTH, HEAT END OF COUPLE SLOWLY, THEN DIP HOT JUNCTION IN MOLTEN GLASS FUSING A SMALL BEAD OF GLASS AROUND EXPOSED END OF PLATINUM TO PROTECT HOT JUNCTION FROM CONTAMINATION.
AFTER INSTALLATION PILE SMALL AMOUNT OF CULLET OVER HOT JUNCTION.

Fig. 3. Spout Thermocouple Assembly.

(Right). Fig. 4. Glass forehearth piping, with the hook up shown (lower left) in Fig. 5. The lower right diagram (Fig. 6) shows the complete instrument panel layout, which is photographically illustrated on page 368.



centage increase in flow is directly proportional to percentage increase in lift of the valve stem), and with an absolutely constant BTU value for the fuel, such a scheme would be practical. However, perfection does not exist in actual operating conditions, and a change or discrepancy in any of these factors would affect the results.

A pressure Stabilog was therefore added to the system. This instrument was used to operate the valve and its control point was set by the Potentiometer Stabilog. Thus the valve was not called upon to do any "metering"; but the pressure on its operating diaphragm was increased or decreased until it met the change in fuel demand, regardless of any of the variables mentioned.

It was believed that by controlling automatically only the spout temperature, the operators would find only occasional manual adjustment of the channel temperature necessary, except when a change was made in the size or weight of the product. It was found, however, that changes made by operators greatly affected the spout temperature and that the two types of control—manual and automatic—were fighting each other. In other words, the automatic had to compensate for manual adjustments, as the manual adjustments were not necessarily analytical.

Since the first indication that an adjustment is necessary comes from the channel temperature rather than the spout temperature, another pressure Stabilog, operating a valve to the burners in the channel, was installed. The control point of this Stabilog is also set by the Potentiometer Stabilog on the spout, and any change in demand, therefore, immediately changes the BTU supply both to the channel and to the spout. The operator may readily maintain the relation between these two points by the control point setting device on the pressure Stabilog on the channel burners. A desired potential may thus be maintained automatically and the potential can be increased or decreased by raising or lowering the index setting of the pressure Stabilog on the channel burner.

The system includes a two-point Potentiometer Recorder having a scale range from 1800° to 2600° F., with one point recording the temperature of the glass

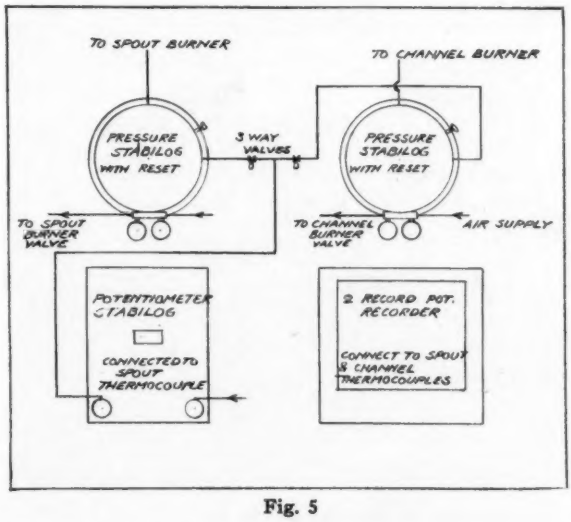


Fig. 5

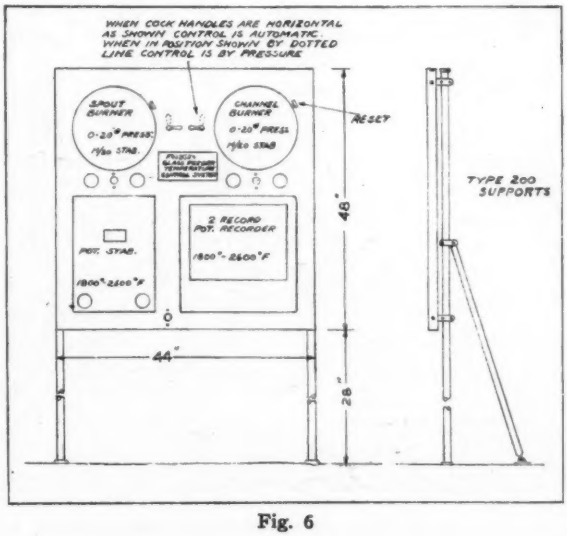


Fig. 6

in the spout and the other the glass in the channel. With these records to guide him, the operator may readily find and maintain the necessary temperature differential between these two points. As the spout temperature is under full automatic control and held to extremely close limits, only an occasional manual adjustment of the pressure Stabilog on the channel burners is necessary to maintain the weight of the product within commercial limits. Accurate records kept over a period of several months showed definitely that there were a great many times when the weight was within limits, without an adjustment of any kind during an entire six-hour shift.

While complete automatic temperature control of the entire feeder could be accomplished, it is felt that in view of the exceptionally good results being accomplished by the present system, the slight advantage to be gained by complete automatic temperature control of both spout and channel would not warrant its considerably greater cost. Automatically controlling the potential relationship is more practical as well as less expensive.

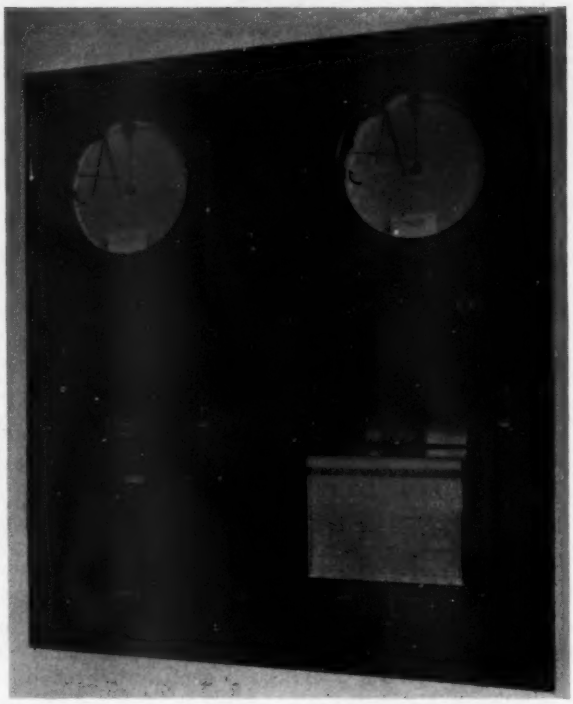
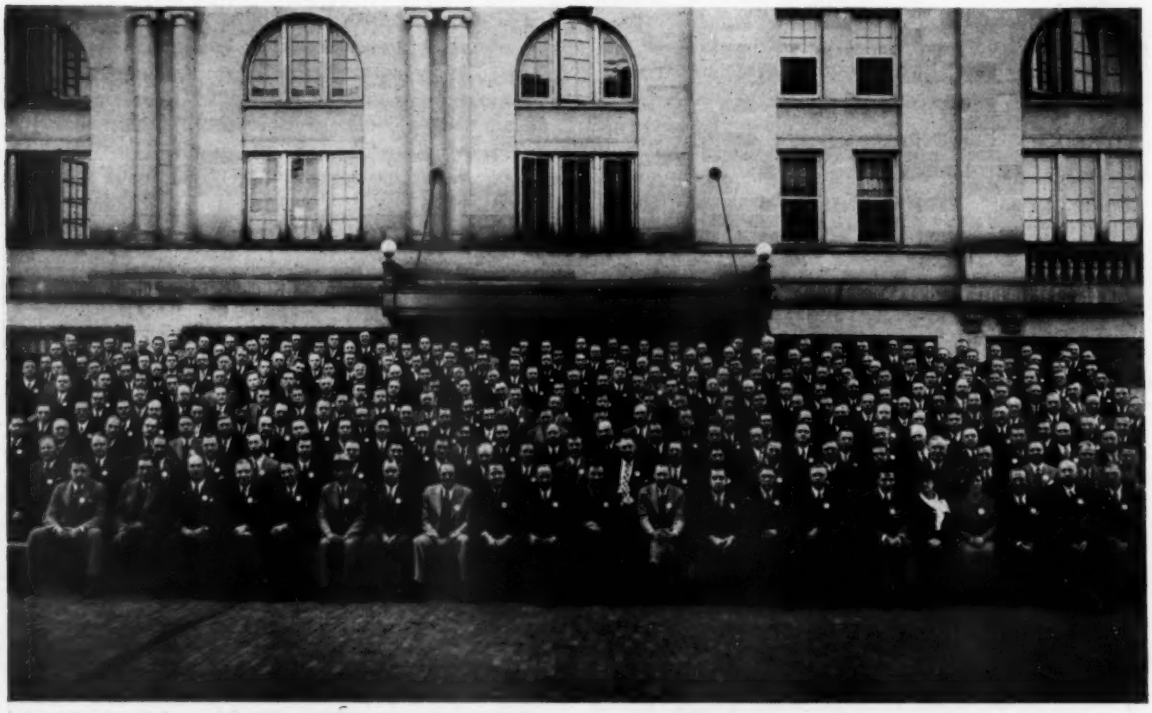


Fig. 7. Instrument panel for forehearth control.

A diagram of the complete system is shown in Figs. 4 and 5. This, of course, covers the special oil-firing system outlined. On a high pressure gas-firing system a similar layout would be used. In the case of an oil-fired forehearth not using the float tank, the Potentiometer Stabilog would reset the control point of Flow Stabilogs on the oil lines instead of the pressure Stabilogs on the air lines. On the low pressure gas burning systems, the system of control would depend upon the particular type of equipment used.

Fig. 6 shows an instrument panel layout for the complete system. It will be noted that each pressure Stabilog is equipped with a three-way cock, permitting the removal of either instrument instantaneously from an automatic control ploint reset by the Potentiometer Stabilog to manual control point reset. This is an extremely dependable method and lends itself to much convenience in starting up or switching over to manual setting in case of emergency.



Representatives of the Owens-Illinois Glass Co. assembled at Huntington, W. Va.

FINING OF SODA-LIME-MAGNESIA GLASSES

By A. E. BADGER

THE presence of seeds in finished glass which has been melted in pots or tanks may be due to several causes, many of which cannot be controlled in commercial practice. The chief factors which influence the seedy condition of glass are the following:

1. *The chemical composition of the glass.* This determines the important physical properties, viscosity, surface tension, and density in the molten state.

2. *The batch composition and the amount of cullet used.* The former partly determines the nature of the dissolved gases in the glass, as well as the composition of the seeds.

3. *The furnace conditions.* This topic consists of a variety of terms, such as the following:

(a) The pull on the furnace (in tanks).
(b) The flow of the glass stream (in tanks).
(c) The temperature of melting and the temperature distribution in the melt.
(d) The type of refractory in contact with the molten glass.
(e) The gases present in the atmosphere above the molten metal.

The great variety of these influences makes the elimination of seeds a difficult problem at times.

EFFECT OF CHEMICAL COMPOSITION OF GLASS ON SEEDS

The following summary pertains to some attempts whicl were made to eliminate seeds from a soda-lime-magnesia glass used for hand and machine blowing. Only Factor 1 above, the chemical composition of the glass, will be considered in this account.

The chemical composition of glasses used for tank melting on large scale production is seldom varied, since even small changes in the physical properties of glass may cause trouble for men and machines, both being tuned to work a certain kind of metal.

The question arose, whether it is possible to make certain changes in the chemical composition of the glass which would produce a less seedy glass, without any pronounced effect on the working properties. Successful results were obtained by increasing the lime-magnesia ratio, the total CaO+MgO remaining unchanged.[1]

RESULTS OF TESTS

The melts were made in closed pots holding about 2,000 pounds of glass. After several trials, it was found that a glass of the following composition was suitable for pot melting, it being plain 36 hours after the last fill.

The batch consisted of sand, soda ash, soda niter, feldspar, burned dolomite and limestone.

In regard to seeds, the above glass composition was proved to be greatly superior to a similar glass in which the dolomitic CaO-MgO ratio existed. Although the latter glass differed from the glass composition of Table I only in the higher ratio of lime to magnesia (total RO being the same), it was not possible to fine it at the regular furnace temperature.

The results of the experiments showed that substitution in the glass batch of lime for part of the dolomite produced a marked improvement in the fining of the metal. On the basis of these results, the improved glass composition of Table I was used for pot and tank production by hand and by machine.

Table I. Glass Composition

Theoretical Analysis	Actual Analysis
72.08 SiO_2	71.0 SiO_2
1.35 Al_2O_3	2.2 R_2O_3
6.50 CaO	6.8 CaO
2.80 MgO	2.6 MgO
0.58 K_2O	
16.69 Na_2O	17.4 Alks.

[1] V. Dimbleby, F. W. Hodkin, W.E.S. Turner (*J. Soc. Glass Tech., Trans.* 5, 353—1921—) found that easier melting glasses are obtained by replacing lime by magnesia up to three-eights of its molecular amount. These laboratory conclusions are confirmed by the factory scale tests herein described.

PITTSBURG PLATE BUILDING AGAIN

An appropriation has been approved for the building of another manufacturing unit for the Ditzler Color Co. plant at Detroit, according to an announcement by H. S. Wherrett, president, Pittsburgh Plate Glass Co. The Ditzler Co. is a wholly owned subsidiary of Pittsburgh Plate and manufactures lacquers and enamels.

SUN FURNACES

One of the most interesting topics discussed at the recent meeting of the Electro-chemical Society was a new furnace which generates temperatures of 5,000 degrees F. solely with the sun's rays. Two mirrors are used in this device which was invented by R. Straubel of Jena. A plane mirror, which follows the sun's motion, reflects its rays into a concave mirror which concentrates them to a fine point in a holder containing material to be melted.

Dr. W. M. Cohn of Berkeley, Calif., used this furnace in the preparation of zirconia, a clear yellowish "glass", used as a lining for kilns and furnaces which operate at moderately high temperatures. Zirconium dioxide melts at 4,850 degrees fahrenheit. When a rod of this compound was placed in the focus of the mirror it was reduced to a boiling mass within 30 seconds. The mass when cooled proved clear like glass, was harder than carborundum and highly resistant to attack by acids and slags.

In speaking of the potentialities of this new type of furnace, Dr. Cohn said, "It is difficult to make an exact prediction of the theoretical temperature limits of the sun furnace. It should be possible, however, to approach the temperature of the sun by increasing the segment of the mirror used and cutting down heat losses."

CHEMICAL EXHIBIT COMING

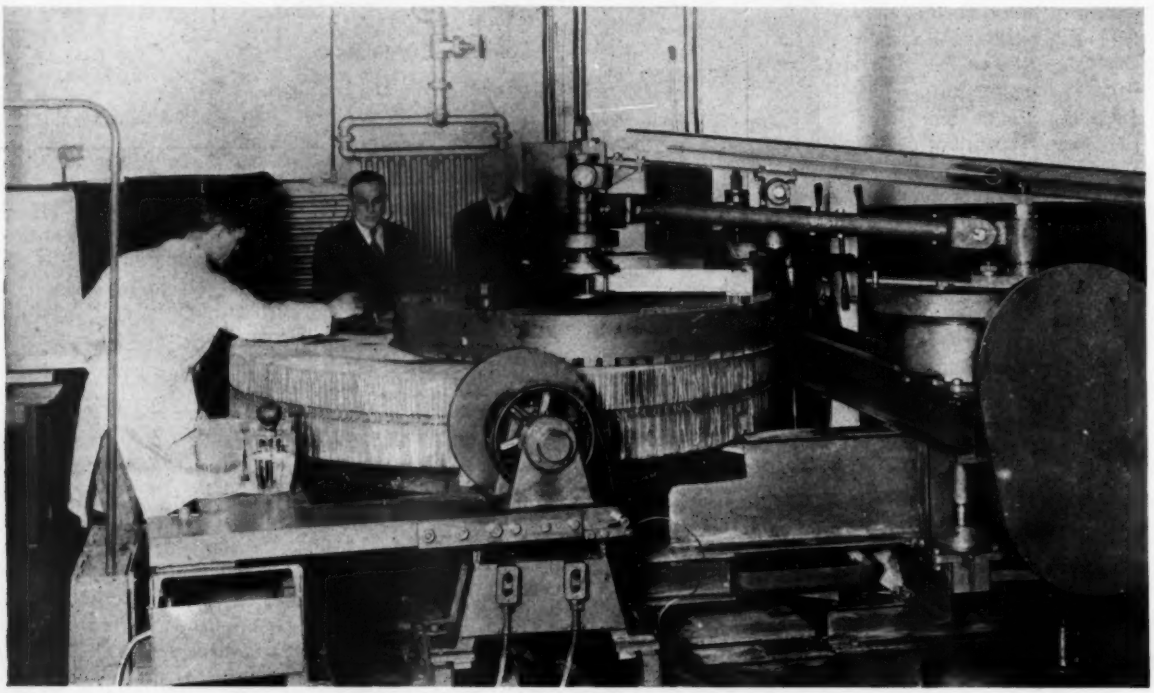
The 15th Exposition of Chemical Industries will be held Dec. 2-7 at the Grand Central Palace, New York. A pageant of products entitled "Children of Recovery" will be presented by the American Chemical Society as the keynote of the Exposition. Many exhibits are planned which should interest members of the glass industry.

NEWS OF THE 82 INCH REFLECTOR

Pouring and annealing the 200-inch reflector at Corning has provided so much news the past two years, that the industry may be said to be definitely "mirror conscious". It will be therefore interesting to have news of the 82 inch disc, also cast at Corning a few years ago, and now undergoing polishing at Warner and Swasey Co., Cleveland. The accompanying illustration shows the casting and the special grinding machinery at work. So delicate is the operation that in the final stages of polishing, work on the mirror will be limited to 15 minutes a day, with time out to let it cool. It is now estimated that another year, or even a year and a half, must pass before the 82 inch mirror will be ready for installation.

The casting of one of these huge discs is in itself such an engineering feat that the glass industry can be pardoned for appropriating to itself much of the credit for building the complete telescope. However, there is more to the job than even the disc. Take the dome of the observatory. Sixty-two feet in diameter and forty-five feet high, with a weight of 125 tons, this had to be built in Cleveland, dismantled, shipped to Texas, hauled by trucks for forty-two miles over mountains, and finally reassembled and erected.

Or consider the electrical problem, solved by General Electric Co. The telescope will be controlled by a panel switch board. Simply by pushing buttons the observer raises or lowers his platform, moves the telescope in any direction, revolves the dome, opens the dome shutters, or raises storm curtains to protect the telescope against wind. When in use, the dome turns slowly, its movement automatically and electrically controlled by a timing system synchronized with the movement of the stars, which it follows precisely. The big dome, incidentally, requires only a 7½ horsepower motor to revolve, and the electrical work employed only four miles of wire.



Grinding and polishing the 82 inch reflector which is destined for the McDonald Observatory

"HOW GLASS BOTTLES ARE MADE"

In a few months' time, Whitall Tatum Company, Millville, N. J., will celebrate its one hundredth anniversary. In anticipation of that important milestone in its history, the company has just contributed a most interesting little book in which Miss Elizabeth M. Bacon describes how glass is made. Who is better qualified to tell the story of America's oldest industry than one of the very oldest glass companies, and a writer whose family heritage has been the glass business for generations?

More persistent than most historians, Miss Bacon begins her account of the history of glass making at the very beginning—with Tubal-Cain, the eighth descendant of Adam. The story enters a more modern era when it relates the story of the Phoenician merchants, who built their fires on the sand about 3500 B. C. And finally, the erection of a glass factory in Millville in 1806, upon whose site one of the great White-Tatum factories is operating today.

The discussion of the actual processes involved in glass making, while done in a popular manner, discloses the authentic touch of actual glass making experience. From here the theme leads quite naturally into a description, illustrated, of the company's own plants and equipment. And though the Whitall-Tatum plants are known far and wide as container factories, the book discloses that the company is a most important factor in the manufacture of glass insulators.

Whitall-Tatum deserves felicitations, not only for the important anniversary it will celebrate next year, but also for the creditable character of its interesting historical sketch. Quite evidently old age has in no way impaired the freshness and vigor of its spirit.

PRACTICAL DECOLORIZATION

THE term "decolorization" as applied to glass-making may be loosely defined as the process of producing colorless glass through the elimination, by either chemical or physical methods or a combination of both, of undesirable colors or tints. While the definition of the term "decolorization" may be thus simplified, the actual process of "decolorization" is such that to continually produce good colorless glass requires much more than the mere knowledge of a few simple rules or formulae. In fact, the glass technologist who will offer the industry such a set of rules that are really workable, under the many and diversified conditions found in actual practice, will be well rewarded by those in close touch with decolorizing problems.

In order to intelligently discuss practical methods of decolorization it is first necessary to briefly review the theoretical phases of the problem. The worst offender in creating an undesirable tint or color in flint glass is iron. Theoretically iron, completely oxidized to the ferric condition, imparts a yellow colorization to glass; while iron completely reduced to the ferrous condition gives the glass a blue color. In practice, however, complete oxidation or reduction of the iron is never attained and the normal iron colors are yellow green or blue green.

However, these two iron colors are of quite different intensities; when the majority of the iron is present in the ferrous condition the blue color predominates and the resulting blue green color is far more intense and more noticeable than when the majority of the iron is present in the ferric condition. If, then, we introduce into the glass batch, materials that have the power of oxidizing the iron present in the batch, the glass will be less highly colored than a glass melted under reducing conditions. This method of decolorization is known as "chemical decolorization". Materials used in this method are oxidizing agents such as nitre, arsenic, barium peroxide, sodium peroxide and the like.

While the use of the above method is sometimes sufficient of itself to secure good decolorized glasses, especially in cases where the iron content of the glass is extremely low,[1] the usual tank flint glasses contain larger amounts of iron and must be subjected to still another decolorizing treatment. As was pointed out before, it is impossible in practice to completely oxidize all of the iron over to the ferric condition. As a result the glass will still possess a greenish color (due to the mixture of the ferrous blue and the ferric yellow) after the oxidizing treatment.

The additions of materials to the batch that will impart a color (pink) to the glass that is complementary to the iron green will cause an optical neutralization and the glass will appear to be free from color. Materials such as manganese dioxide and selenium or selenium compounds, particularly the latter two, are used for this purpose and are known as physical decolorizers, since their action is physical rather than chemical (Gooding and Murgatroyd,[2] however, suggest the possibility of an iron-selenium reaction with the formation of an iron selenide compound). As the selenium pink is not exactly complimentary to the iron green but leaves a residual yellow tinge in the glass, further physical decolorization may be made by using small amounts of cobalt oxide. Cobalt oxide gives a blue color to the glass that is complementary to the residual yellow.

Successful decolorizing, therefore, depends upon the following factors: (1) Keeping the total iron content of the glass as low as possible; (2) the maintenance of an even and correct furnace temperature so as to insure constant operating conditions; (3) addition of the proper oxidizing agent to the batch in amounts that will insure a large conversion of iron to the ferric condition; (4) the proper neutralization of residual tints; and, as will be shown later, (5) the proper cooling of the glass. A general discussion of each of these factors follows.

A good first step to take when attempting to lower the total iron content of the glass is to determine an iron balance. Such a balance is carried out by first determining, through chemical analysis, the iron content of each material going into the batch; calculating the theoretical iron content of the glass produced from the batch, and comparing the amount so found with the actual iron content of the glass as found by chemical analysis. The difference between the actual and theoretical amounts of iron represents iron introduced into the glass by the solution of the refractories and as tramp iron. If the difference is great the characteristics of the block in the furnace are carefully analyzed. Excessive increase in iron content of the glass through refractory solution is usually additional evidence that the refractory is unsuitable and a more resistant block should be substituted in future runs. As the tank age increases the amount of iron introduced into the glass through refractory solution naturally increases. This increase can readily be detected if iron balance determinations are adopted as part of the routine. With a good grade of refractory block the iron contamination through refractory solution is usually small and fairly constant in amount. Usually when large differences are found between actual and theoretical iron content, as determined by an iron balance, they are due mostly to tramp iron.

TRAMP iron finds its way into the glass in a variety of ways and several illustrations will suffice to show the importance of investigating every possible avenue of its introduction. In one instance the cause of off-color glass was traced to the color mixing room. The decolorizer was stored next to a bin containing iron chromate and a loose board was allowing some of the iron chromate to leak through into the decolorizer. In another case a change over from light oil to heavy oil for firing was the cause of off-color glass. The heavy oil contained several per cent of sediment which, on analysis, proved to contain a large percentage of iron. The change back to light oil cleared up the trouble. Heavy oil was again tried but was centrifuged before use. No trouble was then experienced.

While these illustrations are extreme examples, they serve, however, to point out the necessity of tracking

[1] Pesserl, (*Sprechsaal*, 1931, 64,208) claims that glasses containing from 0.02 to 0.04 per cent Fe_2O_3 can be successfully decolorized with 10 parts of nitre and 10 parts of arsenic to 1000 parts of sand.
[2] *Jour. Soc. Glass Tech.*, 1935, 19,72,43-97.

down every possible clue. In most cases tramp iron is introduced into the glass as the result of abrasion of the hard batch materials such as sand and cullet against iron surfaces. The shiny appearance of crusher jaws, screw conveyors, shovels and other iron surfaces coming into contact with the raw materials, or with the batch, is good evidence that abrasion has been extremely helpful in introducing tramp iron into the glass. In an effort to combat this type of "iron introduction", several plants pass the raw materials and finished batch over a magnetic separator, in addition to using special abrasion resisting alloys for crusher jaws and the like. The use of such alloys, besides reducing iron contamination, reduces excessive wear and hence replacements.

The importance of reducing the total iron content of the glass by eliminating excessive tramp iron, decreasing refractory solution, and by the use of raw materials having the lowest iron content obtainable, is easily recognized when it is considered that the less iron the decolorizing mixture must cope with, the better will be the final result, since each successive treatment; that is, oxidation, masking of the residual green, and masking of the residual yellow, decreases the brightness and transparency of the glass. If then the original percentage of iron is high (over 0.1 per cent Fe_2O_3, approximately), such large additions of decolorizer are required as to make the glass grey and dull in appearance.

Maintenance of a proper and constant furnace temperature helps in several ways to secure good decolorized glass. Apart from decolorization proper, constant furnace temperature prevents off-color glass due to changes in flow lines. With an erratic temperature cycle, the natural flow lines in the furnace may be disturbed to such an extent that off-color glass may be drawn into the main glass stream from positions such as dead corners, bottom of tank or areas adjacent to the side walls. Considering the effect of temperature on the decolorizing process, it is known that at glassmaking temperatures ferric oxide dissociates into ferrous oxide and oxygen, and the higher the temperature the greater is the proportion of ferrous oxide formed. However, when arsenious oxide is present in the batch, this temperature effect is reduced to some extent. Arsenious oxide is oxidized to arsenic pentoxide at low temperatures; the pentoxide so formed dissociates at higher temperatures into oxygen and arsenious oxide, and the higher the temperature the greater is the proportion of oxygen produced. The oxygen from the arsenic pentoxide-arsenious oxide reaction upsets the ferric-ferrous equilibrium and prevents the formation of a large amount of ferrous iron.

THE problem of oxidizing the iron over to the ferric condition is usually accomplished by the use of a combination of nitre and arsenic or by the use of arsenic alone. The effect of nitre is three-fold; not only does it oxidize the iron but it assists in converting the arsenious oxide to the pentoxide, in addition to providing oxidizing conditions for the development of the selenium pink. The amount of nitre used in flint glass batches varies from five to fifteen pounds per thousand of sand, with ten pounds being an average amount. Arsenic, in addition to oxidizing the iron, enhances the development of the pink color due to selenium. Both actual practice and experimental research have shown that: (1) when arsenic is used in conjunction with selenium its presence produces a more standard set of conditions, so that a given amount of selenium adds a given amount of pink to the glass; (2) when arsenic is absent from the batch, slight changes in furnace conditions tend to produce off colored glasses. The amount of arsenic necessary for best results depends upon factors such as the percentage of iron present, presence of oxidizing agents, such as nitre; melting temperatures, etc. It is usually best to use arsenic in excess of the theoretical required unit, since it does no harm and prevents the possibility of undercolorizing the glass. The amount varies from two to five pounds per thousand of sand, averaging three.

TABLE I. AMOUNTS OF Se REQUIRED FOR VARIOUS PERCENTAGES OF Fe_2O_3

(After F. R. Pesserl[1])

Percentage of Fe_2O_3 in glass	Amt. of Se in grams per 1000 Kg. Sand	Se: Co Ratio
-0.03	30	——
0.03-0.06	60	20:1
0.06-0.09	120	18:1
0.09-0.12	151	17:1

[1] *Sprechsaal*, 1931, 64,208.

Note: From 0.08 to 0.12% Fe_2O_3, the addition of ZnO up to 2.5% to the glass is advocated to retain the selenium.

The use of oxidizing agents in the batch, in addition to their influence upon the iron and selenium colors, also are useful in destroying carbonaceous material. Carbon gives glass yellow or amber colors which are decolorized through the action of the oxidizing materials. The action is chemical; since the carbon is converted into a gas which in turn is liberated from the glass.

The proper oxidation of a batch fairly low in iron content results in a light yellow glass still possessing a trace of green color due to the small amount of iron remaining in the ferrous state. According to Hodkin and Cousen[3] the amount of selenium required for the optical neutralization of the ferrous iron color is in the ratio of 0.00028 to 1. The amount of selenium required in the total batch is therefore extremely minute.

The addition of such small amounts of selenium to the batch is usually accomplished by the method of dilution. A large quantity of selenium powder is mixed with a fine grained dilutent; such as feldspar, burnt lime, arsenic, or combinations of such materials. Table II gives examples. Mixing is done in a tumbling barrel, or in sieve mixers, every precaution being taken to insure homogeneity of the mixture and to prevent segregation of the mix. The percentage of the selenium in the mixture is then calculated as well as the quantity of the mixture required for each batch. The advantage of this method lies in the fact that the small quantity of selenium needed for decolorization can be more intimately mixed with the batch when it has been previously diluted.

With a standard batch and under standard conditions, the amount of selenium required will remain fairly constant. If, however, changes are made in the batch such as cullet increases or raw material substitutions the amount of selenium must in many cases be varied

[3] *Textbook of Glass Technology*. 133, London, 1925.
[4] *Glass Industry*, 1933, 14,33.

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with the change. Turner[4] has shown that when more than 7.5 parts of ammonium sulphate per 1000 parts of sand are added to the batch the selenium required for decolorization is increased. Bowmaker[5] has shown that the replacement of 2 per cent of lime by the equivalent amount of barium increases the selenium requirements by 30 per cent. He has also shown that a cullet increase of 30 per cent increased the selenium requirements by 25 per cent and that the addition of 40 pounds of borax per 1000 pounds of sand decreases the amount of selenium required by 25 per cent. Bauer[6] replaced 1 part of soda ash by 1.35 parts of sodium sulphate and found that the selenium requirements were doubled.

In actual practice it is often found that the ware coming from the lehr shows different degrees of decolorization. This is especially noticeable when the same lehr is carrying two different weight bottles. These differences are due to temperature variations during the annealing period. Ware taken from across the end of the lehr will also show differences in degree of decolorization, due to the existence of a temperature gradient across the lehr. While there is some doubt as to the correct theory regarding the cause of the color changes of selenium decolorized glasses on heating, the fact remains that it is possible to control to some extent the final color of the ware by varying the soaking temperature in the lehr. If the ware is extremely hot when it enters the lehr, and if the lehr itself is running hot, the ware will come out on the pink side. The reverse is also true, if the ware enters the lehr cold and does not have sufficient time to heat up to the soaking temperature, the ware may come out under-decolorized.

Apart from the effect of temperature differences on

TABLE II. COMPOSITION OF VARIOUS DECOLORIZING MIXTURES

	1	2	3	4	5	6
Arsenic	20	28	4	20	—	38
Selenium	12	20	3	15	2	12
Sodium Selenite	—	—	—	—	2	—
Cadmium Sulphide	—	3	0.5	—	—	—
Cobalt	0.5	—	—	—	—	—
Feldspar	—	—	23	40	86	—
Lime	—	—	—	—	—	35
Nickel Oxide	—	—	—	—	2	—

[5] *Jour. Soc. Glass Tech.*, 1935, XIX, 73,40.
[6] *Glashutte*, 1932, 62,559.

the decolorization of light ware and heavy ware, an important point to bear in mind when measuring the success of decolorizing is the effect of glass thickness. Two bottles of different thickness made from the same feeder at the same time will show different degrees of decolorization. The thin-walled ware will usually appear perfectly decolorized if the thick-walled ware is underdecolorized. This difference is due to the fact that the intensity of the tint is proportional to the thickness of the glass. If it is important to have the heavy ware of good color, the decolorization process must be so regulated that the heavy ware is perfectly decolorized and precautions taken to prevent over-decolorization of the light weight ware.

While it is not possible to give remedies for every off-tint that develops during the production of colorless glasses the following off-tints and their most common causes will assist in diagnosing the trouble:

Color	*Cause*
Pink	Excessive amount of selenium, lehr too hot.
Amber	Excessive amount of selenium in absence of oxidizing agents; excessive amounts of sulphur or carbon compounds.
Yellow (deep)	Excessive amount of iron (in ferric state).
Yellow (light)	Insufficient cobalt in decolorizer.
Muddy	Sulphur or carbon not completely oxidized.
Green	Insufficient selenium or oxidizing agents.
Blue-green	Excessive amount of iron (in ferrous state).
Grey	Excessive decolorization due to excessive amount of iron in the glass.

NEW GLASS BLOCK OUTPUT SPEEDED

Development of an improved glass block for building purposes, which has stood up under pressures of 72,500 pounds to a single block and which reduces heat flow, deadens sound, transmits and diffuses light, deflects sun glare and resists fire, has been announced by the Owens-Illinois Glass Co. This announcement followed the completion of exhaustive tests by the engineering department of Purdue University.

According to the announcement these glass blocks will cost less than other glass masonry construction and they compare favorably with average quality glazed steel sash. Variations between 11.7 per cent and 86.5 per cent transmission of light are possible depending on the type of face cutting desired. The blocks also practically eliminate condensation on the inside walls. Tests showed that there was no sweating when the outside temperature was 16 degrees below zero with an inside temperature of 70 degrees and a humidity of 40 per cent. Expansion and contraction with temperature changes correspond closely with those of mortar and steel.

The Purdue tests showed that the glass block is one of the best insulators among building materials and that a large percentage of any heat flow passes through the mortar joints and block beds, rather than through the hollow interior which is a partial vacuum. The tests also showed that the glass block withstood an ultimate pressure of 2000 pounds to the square inch, although the most stringent building regulations require only 700 pounds.

These new blocks are to be used partially in the construction of a building to be erected in the housing research development of the Purdue Research Foundation. And at the same time, Owens-Illinois is building a large all-glass laboratory building which will use glass blocks entirely. Glass wool will be used for insulation of the roof and for air filters in the air conditioning system of this building which is to be devoted largely to packaging research.

SOLAR REFRIGERATION

Otto H. Mohr uses the sun's rays for refrigeration. A glass sphere filled with liquid is used to heat liquid ammonia water in a tank. The ammonia which is thus vaporized passes through condensing tubes which absorb the heat and convert the vapor to a liquid. When the sun sets or the solar unit is covered, the water in the generator cools and begins to absorb ammonia vapor from the return pipe which lowers the pressure in the system and allows ammonia in the receiver to expand and become vapor. This in turn cools the ammonia in another compartment of the receiver which connects to the freezing unit. By a similar action or process, ammonia in the freezing unit cools the interior of the cooling chamber.

The New York Ceramic Association is publishing a complete directory of all the ceramic and raw materials companies in New York state, and have requested that all interested in being included send in appropriate material to Gordon Strubler, Corning Glass Works, Corning, N. Y.

Knox Glass Associates, Inc., Chicago, announces that John B. Sagarra is now in charge of their Chicago office. This office covers Illinois, Wisconsin, Minnesota and Iowa.

NECROLOGY

MARCEL BELLIERE

It is with profound regret and a deep sense of loss that The Glass Industry announces the death of the distinguished Belgian savant, Marcel Belliere of the S. A. Glaver Co., Moustier, Belgium. Dying at the untimely age of 40 before his work had been completed, M. Belliere left behind him a record of great researches on crystals and stones as well as a remarkable collection of stones. His last contribution to American glass-making literature was "The Crystallization of Pseudowollastonite by Devitrification of Glasses" which appeared in the September, 1934, number of The Glass Industry.

RENE LE BROSI

The Structural Glass Co., New York, has announced the death of its president, Rene Georges Le Brosi. Mr. Le Brosi, a native of France, came to the United States some 18 years ago. He was 48 years old at the time of his shocking death from acute leukemia.

HENRY YOUNG

Henry W. Young, assistant to H. A. Galt, vice-president of the Pittsburgh Plate Glass Co. and president of the Columbia Alkali Corporation, died at his home in Barberton, Ohio, on October 21. Mr. Young was 53 years of age and had been in the employ of the Pennsylvania Railroad for some years previous to joining the Pittsburgh Plate Glass Co. in 1917 as division traffic manager. Mr. Young was prominent in civic, church and fraternal organizations and well known in business and railroad circles.

STRAIN TESTING POLARISCOPES

By JOHN W. FORREST
Bausch & Lomb Optical Company

WHEN a sample of strained transparent material (glass, plastics, etc.) is placed in a beam of plane polarized light and observed through an analyzer in the crossed position (that is, set for extinction of light), it will exhibit regions of varying brightness and, if the strains are great enough, bands of color. The location and extent of these regions serve as a means of determining qualitatively the strain in the sample.

In the simpler types of instrument the polarized beam is secured by reflection at an angle of about fifty-six degrees from the polished surface of a plane black glass plate. The analyzer is usually a calcite prism near the eye. This general type of design has the advantage of providing a large sample area at low cost but is subject to two serious disadvantages. At best only about seven per cent of the incident light will be reflected from such a plate. This makes necessary an exceptionally strong source if sufficient light is to be available. Secondly, there is only one angle of reflection from the plate at which polarization is complete. If large areas are used this means that at all points but the center, polarization is not complete, and the condition of complete extinction will fall off from center to side, causing the sides of the illuminated area to appear brighter. Contrast is thus reduced and the areas of weak strain made more difficult to detect at the sides. In such a simple system of polarizer and analyzer, weak strains will appear as light and dark areas of low contrast. It is possible and is a matter of common practice to enhance this contrast by the addition of a retardation plate between polarizer and analyzer. This is customarily mounted permanently in connection with the analyzer. Such a plate transforms the black and white field into one in which the areas are strongly colored, making it possible for the eye to see differences which were not before evident. The contrasting colors produced by the retardation plate are determined by the thickness of the plate and, since certain combinations of color give higher contrast than others, it becomes necessary to determine the best plate thickness to use. It is customary here to use one known as the sensitive tint plate. This plate gives a purple color between crossed Nicols and a green color between parallel Nicols. This sharp contrast of purple and green, as exhibited in the strain figure, makes possible detection of weak strains which would otherwise not be visible.

In accurate qualitative work, there is still a further fact which must be given careful consideration. This is the type and color temperature of the illuminant. The intensity and color temperature of daylight vary widely and are seriously altered by the surroundings. Clear north sky, for instance, has a much greater temperature than an even cloudy sky. These variations combined with the intensity factor may set up quite different conditions on the two sides of a building, so that the essential contrast exists in one location and is quite absent in the other. These latter variables may be completely avoided by resorting to artificial illuminants and adjusting the thickness of the tint plate to secure a color contrast suitable for this fixed set of conditions.

A new polariscope that gives a practically uniform illumination from center to side.

Most of the troublesome conditions have been eliminated in the polariscope shown in the cut. The instrument is provided with a permanently located 500 W. Projection type Mazda lamp and a suitable condenser system. The beam from the lamp falls upon a very finely ground glass window which serves as the illuminant for the polarizer. The polarizing plate is made with a spherical curve so that the light coming to the eye from any point upon it is at the correct angle for complete polarization. This polarizer design was worked out at the Electrical Testing Laboratories and results in a field in which the illumination is practically uniform from center to side. The operator consequently is not required to have one criterion of judgment when observing the center of the field and another when observing the side.

During the series of investigations leading up to the present design, much time was spent in determining the optimum retardation for the tint plate. This work was carried out in conjunction with several of the larger lamp manufacturing organizations and resulted in the choice of the value 565 millimicrons as the best, that is the one showing the best color contrast. All instruments of the type shown are now equipped with such plates. The combination of fixed illumination of a practically constant color temperature with this tint plate and the curved polarizer results in instruments which can be produced with excellent uniformity of properties and which will perform consistently wherever used.

TIBBY-BRAWNER TO REOPEN

The Tibby-Brawner Glass Co., Punxsutawney, Pa., is planning to reopen its plant. The present shutdown is the first in its 70 year career. This firm manufactures hand blown ware for druggists, chemists and perfumers.

PLATE GLASS UP 84 PER CENT

MONTH by month production figures, compiled by the Plate Glass Manufacturers Association, have demonstrated the healthy condition of the plate glass industry and the extent to which it has benefitted by the increasing use of safety glass, the high rate of motor car production and the modernization of retail stores. However, the full extent of the improvement can scarcely be realized even from the monthly reports of the Association. Only when they are tabulated on a comparative basis or presented in the form of a diagram, can the increase be vividly dramatized. Reference to the accompanying table shows that production for the first three quarters of 1936 has run 84 per cent ahead of the same nine months a year ago, and is not far from double that of 1933, while the chart shows that the lowest point in this year's production curve was higher than any previous peak. Careful readers of The GLASS INDUSTRY will note seeming discrepancies between the figures given below and those previously announced in its columns for the period between March and December, 1934. This is due to the fact that the statistics of one additional company have been secured and added by the Association. The figure of 16,592,803 square feet for October, 1935 was not available when the chart was made. However, it is further suggestive of the great gain in production of plate glass.

PLATE GLASS PRODUCTION (Square Feet)

	1933	1934	1935
January	6,188,263	7,607,195	13,365,188
February	4,955,293	7,441,278	13,723,151
March	4,881,322	10,125,470	16,531,950
April	4,679,776	8,873,204	16,998,914
May	7,922,434	8,050,429	14,581,557
June	9,499,260	6,813,410	13,162,515
July	11,350,393	7,538,656	13,908,529
August	11,326,618	7,742,581	14,526,312
September	8,924,666	6,984,704	14,404,060
October	5,793,693	7,819,744	16,592,803
November	4,169,442	6,866,612	.....
December	6,346,645	8,703,695	.....
TOTAL	86,037,805	94,566,978	.....

BOTTLED BEER WILL SAVE THE PUBLIC $67,000,000

Bottle beer drinkers of the United States will save themselves more than $67,000,000 in 1936, providing they continue to order their beverage in the tried and true bottle. This tremendous saving to the public is based on figures published by the American Iron and Steel Institute which states that United States revenue officials predict a 1936 beer consumption of between 48,000,000 and 50,000,000 barrels. Of that amount, about 12,000,000 barrels will be packaged either in glass or tin cans, according to brewery executives. Figuring 330 twelve-ounce bottles per barrel, that will mean 3,960,000,000 packaged units.

Brewers estimate that tin cans for beer cost approximately two cents each, and that bottles because of their multiple trips cost about .03 of a cent per unit, including caps, labels, etc. Obviously, such added costs must be passed on to the consumer in one form or another.

Thus a potential market of 3,960,000,000 packaged units would cost the public $79,200,000 if consumed in tin cans exclusive of the price of beer itself. If bottled, it will cost the consumer only $11,880,000. The bottle means a saving of $67,320,000 to John Q. Public.

CHEWS GLASS IN COURT

To prove that a small amount of glass may be eaten without danger, Dr. Mosby G. Perrow, Lynchburg, Va., director of public welfare, chewed and swallowed a piece of plate glass before astonished jurors and spectators in the Corporation Court of that city. The occasion of Dr. Perrow's gustatory achievement was his appearance as a defense witness for the W. T. Grant Co., Inc., which was being sued for $5,000 damages by Mrs. Bertie C. Conn. Mrs. Conn contended that she had swallowed fragments of glass while eating peanuts purchased from the defendant's store and had suffered injury. Dr. Perrow, in addition to eating, testified that although some of the harder glasses used in chemical laboratories might be harmful, the "ordinary" varieties might be chewed and swallowed without injury. The defendant won the verdict.

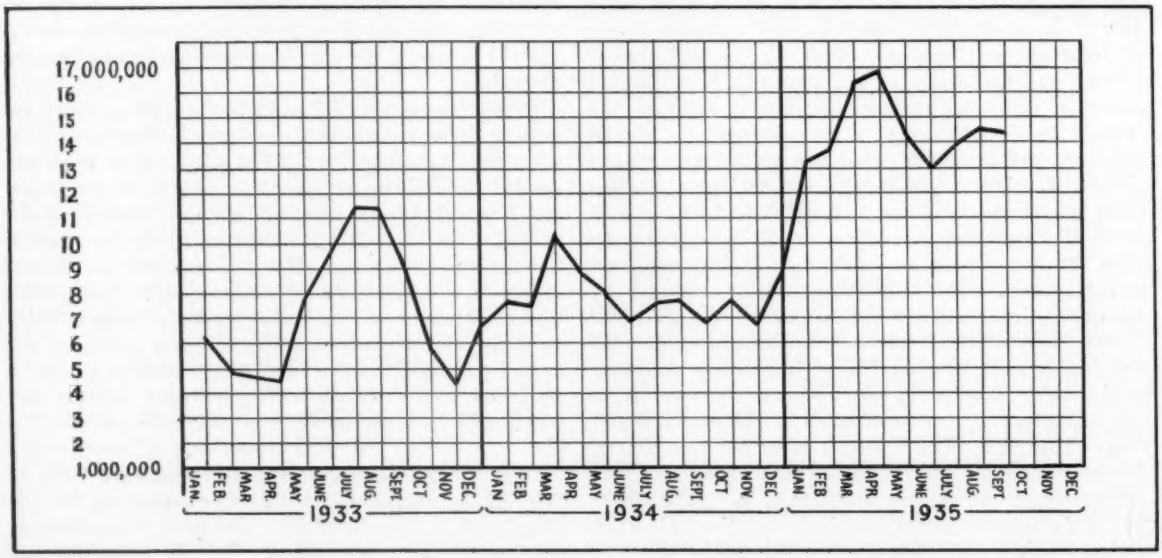


Plate glass production during the last three years (in square feet).

NOTES ON WORLD TRADE IN GLASS CONTAINERS

By CHARLES H. DUCOTE AND EDWARD J. DETGEN
Specialties Division Bureau of Foreign and Domestic Commerce

THE international trade in glass containers is estimated to have amounted to about $15,000,000 in 1934. An accurate figure on this trade is not readily available owing mainly to variations in the statistical classifications of glass products exports of the several countries.

Based on the average annual exchange rates, the eight most important countries in this trade and their dollar equivalent of foreign sales during 1934 were as follows: Germany, $6,761,000; Japan, $1,862,000; United States, $1,519,000; Great Britain, $1,074,000; France, $846,000; Czechoslovakia, $712,000; Netherlands, $277,000, and Belgium $276,000.

Of the ten principal groups into which American glass products exports are classified, "glass containers (bottles, vials and jars)" have been during recent years consistently the most important. Foreign sales of American bottles have been increasing at a rapid rate since 1932. Considerable ground must be retraced, however, before the yearly trade reaches the high values of 1928 and 1929. In each of those years our container exports were valued at more than $3,500,000.

As the table at the bottom of the page shows, Cuba last year jumped into first position as a market for American containers, superseding Canada, and is retaining that position this year despite substantial increases in shipments to our northern neighbor.

DEMAND IN CUBA FOR AMERICAN BOTTLES

The following table of official Cuban statistics clearly shows our position in relation to the Cuban market—which accounted for 28 per cent of our exports in 1934.

As these statistics show, Germany offers the chief competition to American products. This is particularly true in the case of glass bottles of the undecorated type, but even this type of container figured in the increased Cuban imports from the United States. There is very little other competition—the two bottle factories in Habana being reported closed—and with sales for the first six months of 1935 topping the total twelve months sales of 1934, the Cuban picture is very cheerful.

There are several glass container items that are of particular importance in Cuba. They include the 4/5 quart bottle for rum and the small decorative bottle for perfume. An important factor in the manufacture of the rum bottle is the requirement of the United States Treasury that bottles in which distilled liquors are imported into the United States must show certain information blown into the glass. The importance of the perfume bottle arises from the importation of perfumery articles into Cuba in bulk concentrated form—necessitating local bottling.

Cuban Imports of Glass Containers
(Values in Cuban pesos—practically equivalent to Dollars)

Country of Origin	1933	1934
United States	$167,647	$360,378
Germany	81,933	88,298
Belgium	2,531	10,194
France	3,633	9,245
Spain	1,229	12,730
Czechoslovakia	....	621
Others	700	10,330
TOTAL	$260,673	$491,796

THE CANADIAN MARKET

Canada was for many years our leading glass container market, but recently dropped to second position due to the large increase in Cuban imports. A table on page 378 shows the details of the Canadian market for glass containers (to which the United States shipped 27 per cent of its exports in 1934).

The United States position in the Canadian market was less favorable in 1934 than in 1933, although we still supply more than 64 per cent of the Canadian demand for imported bottles. Germany was the gainer in the change, its share of the imports rising from 14 per cent in 1933 to 20 per cent in 1934.

Special shaped bottles for the drug, liquor, and cosmetic trades are the most important types of Canadian imports. More common and bulky articles, such as beer and milk bottles, have never been an important factor as these Canadian needs are supplied by domestic manu-

United States Exports of Glass Containers

Country of Destination	1932	1933	1934	1934*	1935*
Canada	$453,137	$398,672	$419,981	$325,950	$345,847
Cuba	189,693	194,782	436,203	299,717	587,266
Philippine Islands	58,546	97,808	35,597	24,962	49,307
Union of South Africa	39,662	52,387	115,202	61,881	71,951
Panama	37,362	40,467	61,101	37,931	41,790
Mexico	46,340	34,158	58,293	45,544	42,578
United Kingdom	52,867	47,212	22,956	15,635	18,317
Argentina	27,857	27,980	31,252	24,562	18,512
Colombia	20,194	26,039	52,798	34,696	79,587
Honduras	5,026	5,908	7,119	3,538	21,016
Australia	7,183	5,363	6,758	4,784	6,006
New Zealand	15,481	20,407	2,455	1,310	2,423
All other	152,937	164,911	269,194	294,728	252,719
TOTAL	$1,106,285	$1,116,094	$1,518,909	$1,075,238	$1,537,319

(*) January to September, inclusive.

facturers—one Canadian plant in particular which has branches in Quebec, Ontario and Alberta.

No data are available on Canadian bottle production in 1934. In the previous year "pressed and blown glass bottles, jars, etc.," were turned out having a total valuation of $6,690,367. Six plants were listed as working in this category.

Canadian Imports of "Glass carboys, or demijohns, bottles, n.o.p., decanters, flasks, jars and phials."
(Amounts in $ (Canadian)

Country of Origin	1933	1934	1934*	1935*
United Kingdom	62,483	44,968	8,467	8,377
United States	374,401	371,403	95,457	90,001
Czechoslovakia	12,014	20,441	518	1,427
France	14,545	14,855	2,292	2,660
Germany	79,597	114,073	15,193	15,447
TOTAL	557,909	571,966	122,178	119,667

(*) January to March, inclusive.

SOUTH AFRICA PURCHASING MORE AMERICAN BOTTLES

The Union of South Africa has become our third most important purchaser for glass containers—in 1934 over 8 per cent of the total United States exports were shipped to that market. The following is a table showing details of glass container imports into South Africa.

South African Imports of Glass Bottles and Jars.

Country of Origin	1933 Value £	1934 Value £
United Kingdom	39,741	66,858
United States	19,285	33,606
Germany	20,343	24,766
Japan	13,807	17,078
Sweden	2,397	10,919
Czechoslovakia	14,219	9,627
Holland	3,866	5,280
Other	1,200	1,421
TOTAL	114,858	169,555

The South African dairy industry is one of the largest users of glass containers. Considerable progress has been made in the matter of milk handling in the larger cities and the use of glass milk bottles has increased. But the small towns and suburban areas of the larger cities still cling to retail milk sales from bulk containers. Milk bottles are obtained by the dairies either from the one South African producer or from overseas sources. The South African factory is located in the Natal Province and produces all sizes of milk bottles which are sold at competitive prices. Quantities are sold, especially to the small dairy operators. The import trade is divided largely between Great Britain and the United States. American bottles are well regarded and their general high quality appreciated by users. Several makes are being sold through agents and are kept in stock by distributors in the principal population centers of the country.

The manufacturing druggists and the retail chemists are important factors in the small glass container trade. Large, highly organized manufacturers of medicines, ointments, toilet preparations, and associated products do not exist and the market limitations for such merchandise as indicated by the 1,900,000 European/population do not indicate that any large production is contemplated, but there exists a market for glass containers of various sizes. The packaging of imported materials, including petroleum, medicinal oils, ointments, and the bottling of toilet waters appears to be increasing. There is also a considerable volume of cough medicines, prepared ointments, and other patent medicines widely sold throughout the country districts. These are prepared and bottled chiefly by the wholesale and retail chemists.

Japanese products dominate the small bottle trade, although at one time Germany and Czechoslovakia were the principal suppliers. Prices of German and Czechoslovak bottles are reported to be as much as 50 per cent higher than competing Japanese bottles. Japanese competition is confined chiefly to bottles of less than 6 oz. capacity. Phials of ½ oz. to 2 oz. capacity are purchased in quantity from Japan, as are small jars of 1 oz. to 4 oz. capacity.

Jam and jelly jars are supplied chiefly by Great Britain, while the fruit jar trade is dominated by the United States. Although detailed statistics are not available, it has been estimated that over 85 per cent of all jars sold are imported from the United States. Certain trade estimates state that over 50 per cent of the sales are of quart size containers, while 25 per cent are of the pint size. Fancy toilet and perfumery bottles are supplied chiefly by Great Britain, Czechoslovakia, and Germany.

Beverage bottles used by the brewery industry are produced locally by the concern in Natal Province previously mentioned. It is understood that its production is about 15,000 bottles per week.

A report recently received from the Capetown district indicates that there is a possibility of extending the present trade in glass bottles and jars in that area by American manufacturers. The Cape Province is the most important district of the Union for the production of wines and liquors, preserved fruits and jams and preserved crawfish. It also has a number of large producers of proprietary medicines, toilet waters, lotions, cosmetics and special foodstuffs such as catsup, chutney, and honey.

The types of containers which appear to offer the best sales prospects in the Capetown district are: Table sauce bottles, white glass with screw caps; fancy perfume and lotion bottles with and without screw caps; fruit jars pint, quart and half-gallon sizes; and opal jars for creams and cosmetics.

CHINESE IMPORTS DECREASE

Despite the fact that imports of glass bottles into China decreased 50 per cent during 1934 compared to 1933, this market remains an important purchaser of containers. Of the total imports during 1934 valued at 281,417 yuan, Japan supplied over 40 per cent, while the United States provided but 7 per cent. Details of Chinese imports are shown below:

Chinese Imports of Glass Bottles
(Values in Yuan $)

Country of Origin	1933	1934
Japan	280,807	124,765
Hong Kong	65,988	22,050
United States	34,220	24,348
Germany	42,345	34,558
Great Britain	27,883	18,225
Others	66,869	57,680
Gross Imports	518,112	281,626
Reexports	1,920	209
Net Imports	516,192	281,417

(*Continued on page* 385)

GLASS IN MODERN HOUSING

By JOHN ELY BURCHARD

(The paragraphs that follow deal with the properties of different glasses and the uses to which they can be put in construction. They were taken from an address delivered before the American Society of Testing Materials by Mr. John Ely Burchard, vice president of Bemis Industries, Inc. The facts themselves are individually known to glass men; but the weaving of these strands of information together creates a new and inspiring picture. Mr. Burchard's paper will give glass men a better appreciation of the contribution they have made toward modernizing the home, and from it they undoubtedly will be able to visualize more clearly the road that still lies ahead of them.—The Editor.)

GLASS is the romantic material of our age. As Frank Lloyd Wright, the architect-poet of materials, has said, where architects have worked with shadows, they will now work with light, diffused, refracted, and reflected. Modern cities need no longer be sodden imitations of mediaeval strongholds; a modern city of glass will be irridescent by day, shimmering by night.

This gospel of light is a new thing in architecture and glass is its apostle. Among other things it may mean the passing of the transparent window. Lucky the house that has one vista that is worth making a picture of with a transparent window; rare the house, all of whose windows look out upon beauty. But with modern glass we can have sufficient light transmitted with complete privacy, large windows that give us the light of the world by day and that give our light to the world by night, without our having to be any more conscious of the world, or the world of us, than we wish.

Fig. 1 shows just a few of the many commercial forms of industrial glass which are not costly and which might be used in this way in an honest and unusual beauty of their own. Created for utilitarian purposes they may also serve aesthetics.

In smaller places glass can be brilliantly and integrally colored; the mirror used architecturally is a beautiful thing; glass is subject to multitudinous treatments for extra beauty, such as molding in intaglio or relief, sand and acid etching, wheel cutting and painting.

We have realized in our modern housing problems that we have shut too much light from our lives. We want more windows and better placed ones. But we cannot afford to lose the heat that glass so readily transmits. Glass technology is equal to the occasion. It provides us with a new double glass, called Thermo-pane; two pieces of glass separated by dehumidified air and bound together at the edges by synthetic resin. Thus glass is ready for air conditioning.

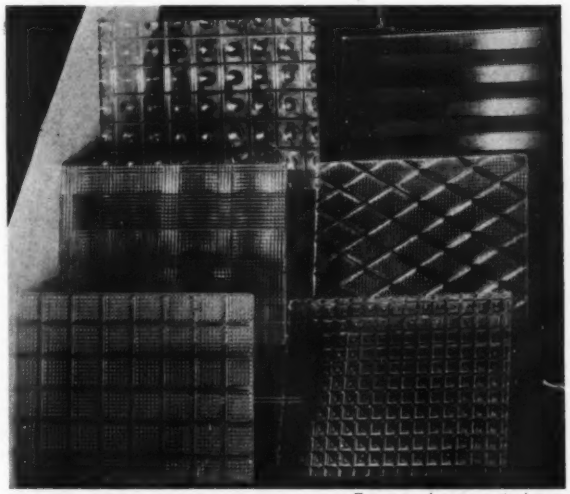
We want to shut out breezes and yet we want the beneficial anti-rachitic effects of ultra-violet light. Glass is prepared for that, too. Although gradually spoiled by solarization, some types will, when new, transmit quite an adequate supply of this beneficial light.

We want summer light without the attendant heat and the glass technologist offers Aklo, a glass which absorbs a large part of the heat rays of the invisible spectrum while it does not rob us of our light, a glass prepared even for the sudden shower following a hot day by being highly resistant to sudden changes in temperature.

Glass eliminates infiltration; it is a good fire stop; it is not porous; does not crack on the surface; absorbs no odor; is impervious to air, water, grease, most acids and all vermin; does not lose its hardness nor its brilliance on exposure to moisture; its polished surfaces do not distintegrate, they retain their lustre and are particularly easy to keep clean.

Hitherto it has shattered readily but today we have laminated glass with which we are all familiar, and a new tempered product in which an inner area of tension is encased in a stronger area of compression which multiplies the resistance to impact many times. The technicians of this industry are most progressive; and they keep faith with their public—they do not announce until they are ready to supply.

Finally, glass has definite structural possibilities. In extruded form it is already used for railings and balusters and towel racks. Its tensile strength is about 10,000 lbs. per square inch, its compressive strength greater than that of ordinary structural materials like granite, concrete or brick. The glass brick (Fig. 2) used abroad for 15 years and here for six, with or without a partial vacuum inside, laid in mortar, was demonstrated at the Century of Progress. Its compressive strength permits light-transmitting walls of indefinite size which are, however, limited by expansion considerations that do not arise within the dimensions of an ordinary house.



Courtesy *American Architect*

Fig. 1. Some modern industrial glass.

These bricks have considerable insulating value. They may be colored on the sides to produce limitless color effects while transmitting white light. At present the cost is very high but they are in their infancy. They are one of the most intriguing new materials.

I do not apologize for my eulogy of this magnificent material. Glass is very old but has almost always been precious. No longer need it be precious as to cost. True

recognition of its magnificent properties and full use of them can alter that. The glass mosaics of Rome, the glass paintings of the Gothic window, were eloquent testimonials of culture. Today we may step inside the main entrance of Rockefeller Center in New York and find other eloquent testimony. Here is a glass wall in sculptural planes scattering and redirecting the rays to give abundant light while retaining its own beautiful pattern for him who wishes to see.

The House of the Future

The houses of the future will have fewer eyes. They will look inward, not outward, but they will bring in the light they want and the views they want. They will be heated in cleaner ways and finished in cleaner ways. Their air will be washed and cleaned and always at a comfortable temperature. Metals and wood and glass will abound. Finally, they will be more flexible in plan.

For countless years the Japanese have realized the folly of fixed partitions and have made their rooms perform varying services through the use of screens. The great German architect, Mies Van der Rohe, has realized that too. He builds houses with few partitions and like the Japanese uses movable walls. With the growth of the

Courtesy *American Architect*

Fig. 2. Glass bricks in a modern factory.

prefabricated small house we will find more built-in furniture and also closets like walls that are portable, to form separations of room and rooms that may be varied when needed and will serve meanwhile for the all-essential storage space that the Japanese do not need but that we string-saving Westerners do.

Our lights will be provided in coves, again associated with glass, and we will no longer use lighting fixtures wedded to the anachronism of the candle or the oil wick. The whole house will be light and clean and free. These things are coming rapidly—really evolution, some of the changes will look like revolution.

We are also on the verge of a revolution in materials for this housing. The revolution will be less in using unknown materials than in giving up many of our old conceptions and in taking up with fresher ones; giving up some of the traditional materials and accepting others that have been begging at our doors for a long time. If our architects cannot rise to an opportunity that Frank Lloyd Wright has been preaching these 30 years, our industrial designers will.

But neither the old nor the new materials will live up to their full promise if they are not subject to one common leaven for which the American Society for Testing Materials has long worked. I refer to standardization. The Society has already accomplished much with standard specifications. But there is much yet to do. If prefabrication comes, it will not all be done by one large corporation. The various prefabricating units will unquestionably buy their materials from some of the same materials manufacturers. A sound basis of standardization is necessary if prefabrication is to come; sounder than is now needed when everything can if necessary be cut and fitted. General Houses and American Houses and all other Houses must be able in the future to buy their material standardized in dimensions that will make them more adaptable to each others' designs.

The standards of glass must agree with those for wood and steel and aluminum and cloth and fibreboard. A frontal attack must be made on this problem of standardization before individual materials can be used to their fullest advantage.

PITTSBURG PLATE EMPLOYS NOTED STYLIST

The Pittsburgh Plate Glass Co. has retained the services of Walter Dorwin Teague, noted designer and decorator, and his staff, to develop new uses and designs for glass. Mr. Teague has also been retained by such other outstanding firms as Eastman Kodak, Ford, Texas Oil and his work in their interest has gained him a nation-wide fame. Among his better known accomplishments were the exhibits in the Ford Building at the Century of Progress and the designing of 50 modern streamlined coaches for a railroad.

A report from Chicago states that building trades expect department stores to handle complete air-conditioning equipment for homes within five years.

BUILDING BOOMS IN NEW YORK

According to the Dow Building Reports a phenomenal, last minute building stampede, involving $85,000,000 to $90,000,000 of contract awards is under way in New York and vicinity. The cause is the recent ruling from Washington which says, in effect, that if work on projects for which money has been granted is not under way by December 15, the funds will be withdrawn. About 125 projects in metropolitan New York and New Jersey are being rushed to beat this deadline.

October was the biggest building month in New York since 1931, with permits totaling $21,114,605. The first ten months of this year have shown a building permit valuation of $125,402,239 as compared with $72,692,718 for the same period of 1934.

The Dow Service predicts that building construction in greater New York for 1935 will total close to $150,000,000 calculating values on a permit basis. The value of plans filed, however, is usually notoriously lower than the figures at which the work is awarded to builders and hence, according to Dow, represents not more than 80 to 85 per cent of the real contract award value. On this basis, Dow figures the value of building construction will actually be about $172,500,000.

O. Hommel Co., Pittsburgh, reports light pastel colors will be favored for decorating glassware this coming spring.

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Dr. Flint's Washington (Pa.) house is just to the right of the cross. This view was taken from the east.

MOVEMENTS OF GLASS MEN

Francis Flint, chief chemist, and much besides, of the Hazel-Atlas Glass Company, has recently moved from Washington, Pa. to Zanesville, Ohio. In order that his friends may estimate the desirability of his new location, we present them herewith with aerial views of both places. Fig. 1 shows the eastern section of Washington, Pa., with Dr. Flint's house right in the center (X marks the spot), a house built in a very unusual design, one of his own, possibly betraying Californian influence, or possibly a fear of six-foot angle worms, the entrance to the house being well hidden in an unexpected corner.

Zanesville is shown in Fig. 2, with the famous three-legged bridge across the Muskingum in the foreground, and immediately across the river is the No. 1 plant of the Kearns-Gorsuch Glass Company, owned by Hazel-Atlas, where Mr. S. B. Bowman's General Manager's office is. We presume Dr. Flint's will be hard by.

The U. S. National Pike crosses the three-legged bridge on its way to Columbus and points west (towards the observer), and on its way east to Wheeling, West Virginia and Washington, Pa. (towards the distant parts of the view); but it is further to Cove Point from Zanesville than it is from Washington.

Zanesville from the west, as the shadows lengthen.

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MODERNIZATION ON CREDIT

THE glass manufacturing industry, like every other one, has had preached to it the sermon of modernization until everybody knows all the phrases by heart.

What to do, however, has been less of a problem than how to do it. Structural changes in factory buildings cost money, and so do machines and equipment. Paying out a relatively large sum of money at once for such things is not always convenient.

Under the Modernization Credit Plan of the Federal Housing Administration the glass manufacturer can do the things he wants to do in the plant and spread the payments over a considerable period. If the improvements are well conceived, it is possible they will pay for themselves through increased production and savings that are brought about with modern machinery.

The Modernization Credit Plan permits borrowing from a private financial institution for plant repair and improvement and for the purchase of certain machinery and equipment. It permits an insured loan to plant owners of any amount up to $50,000 for these purposes, which is to be repaid in equal monthly installments over a period as long as five years.

The money is obtained, NOT from the Federal Housing Administration, but from a private financial institution holding a Federal Housing contract of insurance, such as a bank, trust company or building and loan association. The charge is a matter to be determined between the borrower and lender, provided it is not in excess of the maximum rate fixed by the Federal Housing Administration. This maximum rate is $5 discount per each $100 face amount of a one-year note payable in equal monthly installments.

Virtually any type of structural changes may be made with the funds so derived. Equipment necessary to the operation of the building may be installed—elevators, heating plants, sprinkler systems and the like.

The machinery that may be purchased must be essential to the operation of the building. It should be of a value sufficient to warrant its purchase on a time-payment basis. It should be of a durable nature with a reasonable expectancy of useful life longer than the term of credit extended for its payment. It must be purchased and installed as a part of the equipment of a structure or of the business conducted therein, within the United States or its territories and possessions. Hand-tools, small portable appliances, fragile articles, furniture (unless built in), furnishings, removable decorations and installations meant to be or by their character necessarily temporary, are ineligible. Loans for the purchase and installation of replacement parts for eligible equipment and machinery are insurable, but a loan merely for the repair of a machine is not insurable. As an example, the cost of welding a fly-wheel may not be made the basis of an insured loan, but the purchase price and installation cost of a new fly-wheel would be insurable.

From the general outlines it will be observed that a vast quantity of machinery and equipment used in the manufacture of glass may be purchased with modernization credit. Most manufacturers know whether or not the equipment they sell is eligible for purchase. Where doubt arises, a ruling may be obtained promptly by writing the Federal Housing Administration, Washington, D. C. giving full particulars.

There are several advantages in the use of the Modernization Credit Plan. One is the fact that the payments may run over a period of five years if the borrower desires. Most installment credit systems require that payments be made in 12 to 18 months. Another advantage is that a down payment is not required. With almost all other systems the down payment is from one-fourth to one-third of the purchase price. Further, the maximum charge is less than that which applies in other installment systems. The most favorable usually call for $6 discount per $100, whereas with the Federal Housing plan the maximum is the equivalent of $5 discount per $100 face amount of a one-year monthly installment note.

Originally, the National Housing Act fixed $2,000 as the limit an individual, partnership or corporation could borrow for repair and modernization and the money had to be spent on the real estate. This proved to be not enough for certain purposes, including the modernization of industrial plants, so Congress amended the law, increasing the amount that could be borrowed under certain circumstances to $50,000 and allowing it to be used for the purchase and installation of certain machinery and equipment as well to improve real estate.

The borrower need not be the owner of the real estate he seeks to improve. He is not required, even, to have a lease, although he should possess some evidence of his right of occupancy.

The law limits the time of the operation of the Modernization Credit Plan to April 1, 1936. Manufacturers contemplating the improvement of their plants, either structurally or through the installation of new machinery, are advised to act promptly.

LADIES CROCHET GLASS

Mrs. John H. Thomas, Newark, Ohio, wife of one of the Owens-Illinois research workers, is said to have the distinction of being the first woman in the world to crochet a hat of 100 per cent glass yarn. Mrs. Thomas selected a blue glass yarn and then knitted herself a purse to match the hat. The girl employees in this O-I plant are said to have embroidered doilies and have even knitted sweaters from the glass thread.

This glass yarn was developed while working on the problems of glass insulation and has been found commercially practical as insulation for the finest electric wires as well as for large cables. Very attractive patterns and textures can be worked out with it and it may be possible to use it in fabric looms in the same way that other yarns are used.

By a special process the molten glass is blown onto a conveyor belt in a whispy form. It is then wound on spools as "sliver" which is twisted onto other spools as yarn and thread of varying sizes on machines adopted from the textile industry.

BRITISH SOCIETY MEETING

The first meeting of the Society of Glass Technology for the 1935-36 session was held in Sheffield on Oct. 16. Bernard P. Dudding delivered his presidential address entitled "Meditations, Speculations, Aspirations."

EQUIPMENT AND SUPPLIES

DRAKENFELD EXHIBITS

Among the exhibitors at the Third Annual Industrial Materials Exhibit at the Hotel Astor, New York, was B. F. Drakenfeld & Co. with a display of its ceramic materials and other industrial chemical products. Their display included samples of various chemicals, raw materials and colors used by the glass, pottery, porcelain enamel, tile, terra cotta and heavy clay products industries, as well as finished articles in which the various materials are utilized.

The Drakenfeld exhibit is pictured in the accompanying illustration. At the right may be seen a cabinet containing a line of bronze powders said to be the most complete in the world. The beauty of the display was considerably enhanced by indirect lighting.

CATALOGS RECEIVED

A New Application of the Ritex Process to the Manufacture of Chrome Brick. General Refractories Co., Philadelphia. By R. P. Heuer, Director of Research for the company.

Fire Tamers. Johns-Manville, 22 East 40th St., New York City. A story of research and development in the refractory cement business, suggesting with ample illustrations ways of checking the ravages of flame on furnace walls.

Wheelabrating. Book No. 111. American Foundry Equipment Co., Mishawaka, Ind. Describing the use of a mechanical device for throwing abrasive by centrifugal and tangential force onto products to be cleaned, such as castings or forgings, or for preparation of a base finish.

Brown Air Operated Controllers. Catalog 8900. Brown Instrument Co., Philadelphia. Attractively presented and amply illustrated catalog of controllers for temperature, pressure, flow and liquid level.

Self-Aligning Roller Bearing Units. Book No. 1494. Link-Belt Co., 910 S. Michigan Ave., Chicago. A new line of self-aligning, double row roller bearing units in standard sizes is introduced in this booklet.

GOES TO CHINA

The Hartford-Empire Co. reports their first shipment of a feeder to China. The Tswing Hwa Glass Factory has purchased a Hartford-Empire Single Feeder and a Lynch No. 10 forming machine, which will be shipped to the Far East the early part of this month.

LINK-BELT MOVES

The executive offices of Link-Belt Co., for many years located at 910 S. Michigan Avenue, Chicago, have been moved to the Bell Building, 307 N. Michigan Ave., where they will occupy the entire twenty-third floor, and the north half of the twenty-first floor.

The Link-Belt Co., has appointed T. Frank Webster, resident manager of its Boston office succeeding Horace Goldstein who has been assigned to engineering sales work at the Philadelphia office. Mr. Webster was formerly resident manager at Pittsburgh.

THWING CHANGES NAME

Dr. Charles B. Thwing, president and founder of Thwing Instrument Co., Philadelphia, makers of high grade pyrometers and paper testing instruments, announces that hereafter the company will be known as the Thwing-Albert Instrument Co. This change is one of name only, since no change in ownership, management, policy or product is involved. Edward J. Albert whose name is now associated with Dr. Thwing's has been with the company for 17 years as manager and secretary.

NEW BAR STOCK

A new composite stainless steel bar stock known as Silverbond, for which patents are pending, has been developed by Jessop Steel Co., Washington, Pa. It is for use wherever the bar surface must be corrosion and temperature resistant.

It is described as a web-like structure with inexpensive low carbon inserts up to 40 per cent mechanically held and welded by pressure applied at high temperatures. The cladding may be varied from 10 to 25 per cent, depending upon the application.

Rounds, flats, octagons, hexagons, sheets, strips, etc., are available. Present uses include: refrigerator trays and accessories, shaftings where machining is not required, and architectural and general decorative trim.

IMPROVED LIFT TRUCK

Elwell-Parker Electric Co., Cleveland, has designed a new elevator truck, Type ELN-6. It has a capacity of 6000 pounds and may be powered by either electricity or gas-electricity.

Chains are used for hoisting and lowering loads instead of cables because they are said to increase efficiency and simplify construction. The operator stands on rubber pedal pads which absorb the vibrations when traveling over rough surfaces. The truck has telescoping uprights and the platform will elevate 62½ inches before the inner uprights begin to operate. Thus it is possible to tier loaded skids in

box cars or other places having low headroom. In a warehouse or in the open it is possible to raise the loaded skid 10 feet or more.

The truck is 41 inches wide and 128 inches long with 27 x 54 inch platform. The height of the platform in low position is 11 inches. The truck itself steers on all four rubber tired wheels and may be turned in 66 inch intersecting aisles.

INCREASING LIFE OF GLASS SHEAR BLADES

The life of glass shear blades is said to be increased 10 times by hard-surfacing the blades with a cobalt-chromium-tungsten alloy. These blades are used for cutting off the surplus glass from the suction mold used for making blown water glasses. And since the glass is red hot and plastic at the time of the cut, the blades must operate at extremely high temperatures. It is claimed that both tool costs and shut-downs are greatly reduced through the use of these hard-surfaced blades. One-tenth of a pound of the alloy and five minutes of welding time are required to protect each blade.

HEATER LINE INCREASED

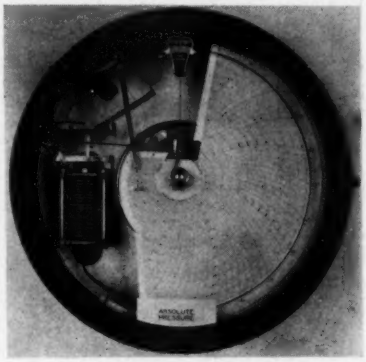
The Fedders Manufacturing Co., Buffalo, N. Y., has added seven sizes to its line of Series 3 Unit Heaters, making 20 standard models in their line. This addition is said to make not only for a completeness of the line but to assure a well-graduated spacing between each capacity to make for greater economy in heat delivery and in initial cost for each particular type of job.

A NEW BANDING WHEEL

A new, improved banding wheel, or whirler, for glass and pottery decoration and potting is now being manufactured by the O. Hommel Co., Pittsburgh, Pa. This new banding wheel is said to give perfect service, and be practically everlasting. The unique features of this wheel are the replaceable bearing point and seat of special heat treated steel which are so accurately ground that they never wear. Moreover, should either bearing point or seat be damaged as a result of careless handling, they may be easily replaced at small expense.

MEASURES ABSOLUTE PRESSURE

Foxboro Co., Foxboro, Mass., has developed a new gauge to measure absolute pressure. The pressure measuring and barometric compensation units are mounted together forming a complete, rugged and integral actuating movement. Two hydrons, one measuring direct pressure and the other barometric pressure are so connected that their pressures directly oppose each other, thus enabling the measurement of only a true absolute pressure. This gauge is protected against over-range, is light and portable, contains no liquid to spill or lose its seal and may be equipped with a Foxboro Stabilog mechanism.



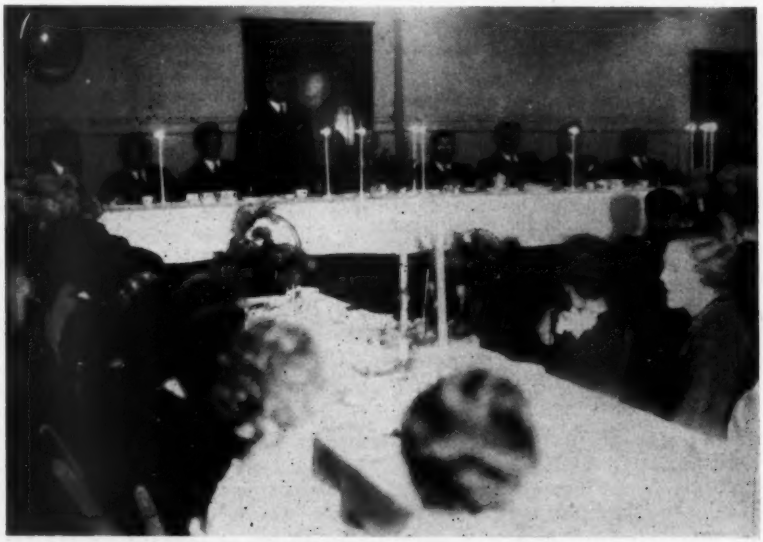
OVERMYER MOULD CO. HONORED ON FIFTEENTH BIRTHDAY

More than 300 employees, representatives of glass companies and Winchester business men gathered in Winchester, Ind., at a banquet to honor C. P. Overmyer, Sr., founder and president of the Overmyer Mould Co., who built up the business from a 40 foot machine shop in 1920 to a $400,000 factory employing 300 workers at an average weekly payroll of $45. per employee. The entire city of Winchester joined in the celebration and tribute under the leadership of Mayor John P. Clark.

Mr. Overmyer recounted the story of the growth of the company in an extremely interesting manner. "Our first 17 months business only netted us $28,000," said the founder, "but our prospects for next year are at least three-quarters of a million. If every glass factory in the world were unroofed tomorrow the sun would shine on a mould made in Winchester in the Overmyer machine shops."

Indeed, the story of Mr. Overmyer's career is a saga of the rise of a man who has concentrated his every effort and idealism on the development of a single important industry. Starting work at 12 years of age, Mr. Overmyer finally became an apprentice mould maker in Marion in 1901. He said his first week's pay as an apprentice was $6, an additional bonus being added for him to the usual rate of $3.50 per week.

Thus, Mr. Overmyer and his company have grown together to occupy a prominent place not only in the community of Winchester but throughout the world wherever glass is manufactured.



Scene at banquet in honor of C. P. Overmyer.

GLASS CONTAINER WORLD TRADE

(*Continued from page* 378)

Recent years have witnessed a substantial increase in manufacturing activity in China, and many products which require bottles in packing, such as perfumery, wines, beer, spirits, ink, cosmetics, bottled waters, chemicals, and drugs have been produced in increasing amount. This is believed to have stimulated the demand for and domestic production of containers which probably accounts in part for the decrease in imports during 1934.

GERMANY IS LARGEST EXPORTER OF BOTTLES

Germany advanced in 1934 as a progressive leader in glass container exports. The following table shows her leading markets:

German Exports of Glass Containers

Country of Destination	1933 1,000 R.M.	1934 1,000 R.M.	1935* 1,000 R.M.
Great Britain	2,839	4,875	1,278
Switzerland	891	1,437	333
Netherlands	1,404	1,215	412
Belgium	558	522	164
Union of So. Africa	332	414	134
Norway	405	410	180
Austria	220	389	130
Canada	191	302	18
United States	187	187	20
Cuba	195	146	116
Others	6,455	7,007	3,227
TOTAL	13,697	16,904	6,012

(*) January to June, inclusive.

German production capacity in 1931 was estimated to be 640,000,000 bottles—although that year only 168 millions were produced. The production of bottles is carried on mainly in the Rhineland, Weser and Thuringia districts.

Although domestic sales have increased somewhat since the depression low, the organized bottle factories have been operating at only about 20 per cent of pre-war capacity. (See November GLASS INDUSTRY for details.)

JAPANESE CONTINUE LARGE EXPORT GAINS

Activities of Japanese glass bottle manufacturers this year in the foreign field have been productive of increasing business. In the first six months of 1935 shipments of glass containers, exclusive of vacuum bottles, amounted in value to 2,717,321 yen, as compared with 2,135,419 yen for the same period of the previous year. The table below will be of interest in comparing the principal markets for Japanese bottles:

Japanese Exports of Glass Bottles (except Vacuum)
(Values in 1000 yen)

Country of Destination	1933	1934
British India	1,680	1,795
Dutch India	750	853
Philippine Islands	397	511
Union of South Africa	255	385
China	466	373
Australia	211	219
United States	201	256
Other	1,165	1,980
TOTAL	5,125	6,372

Recent estimates reveal that Japan exports approximately 36 per cent of her glass container output, based on the 1934 production value of 17,359,600 yen. This is said to be due in large part to the favorable exchange rate of the yen, and the joint efforts of manufacturers in the development of new equipment and plants, as well as the activity of trade unions and manufacturers organizations cooperating in control and general trade problems. The containers produced by Japan range from ordinary liquor bottles to highly specialized decorated types.

UNITED KINGDOM IMPORTS MANY BOTTLES

The United Kingdom holds the unusual position of being both a leading importer and exporter of glass containers. In 1934, she imported bottles to the value of £266,524 and for the first six months of 1935, £140,537.

On the other side of the ledger, exports for 1934 were valued at £223,558, and for the first six months of 1935, £112,099. Details of the trade in these years are not available but the 1933 statistics suggest her leading sources of supply and markets:

Exports 1933

Destination	£
China	21
Other Foreign Countries	41,873
Total Foreign	41,894
Irish Free State	93,029
Union of So. Africa	34,178
India	30,743
Other British	46,926
Total British	204,876
Grand Total	246,770

Imports 1933

Source	£
Sweden	23,596
Germany	115,819
Netherlands	18,798
Belgium	10,931
Czechoslovakia	35,805
France	23,120
United States	9,346
Other Foreign	4,842
Total Foreign	242,268
Total British	9,314
Grand Total	251,571

About one-quarter of the British import and export glass container trade consists of bottles for wine, beer and liquor. Practically no milk bottles are imported or exported. The balance of the trade is in bottles for medicinals, drugs, cosmetics, etc. About 96 per cent of British imports come from foreign sources while 83 per cent of the containers exported are marketed within the British empire. Germany, Czechoslovakia, and Sweden are the chief foreign sources, with Germany supplying 45 per cent of the total imported. The Irish Free State, British India and Union of South Africa form the chief foreign markets, with the Irish Free State purchasing 46 per cent of the total.

The only official figures on the production of glass bottles and jars in the United Kingdom apply to the year 1930. These figures show that a total of 8,467,000 gross of glass bottles and jars were made in that year of which 3,624,000 gross were beer, wine, spirit and other bottles, the remaining 4,843,000 gross being made up of other types of bottles and jars. (*Concluded on page* 387)

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks ...	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 130 lb. carboy ext.	Per 100 lb.	...	5.50
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	...	Po. or Gr. .25 / Cry. .25½
Aluminum hydrate (Al (OH)₃)	lb.	.04-.04½	.04½-.05
Aluminum oxide (Al_2O_3)	lb.	.04	.05
Ammonium bicarbonate (f.o.b. works)	lb.	.0515	...
(f.o.b. N. Y.)	lb.	...	.0571
Ammonium bifluoride (NH_4FHF)	lb.	...	.14½
Ammonium nitrate (NH_4NO_3)	lb.	...	.08
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimonate of Sodium	lb.	...	.10½
Antimony oxide (Sb_2O_3)	lb.	...	15¾
Antimony sulphide (Sb_2S_3)	lb.	...	.13
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04-.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite)			
90%, 99% through 200 mesh	ton	40.00	45.00
90% through 100 mesh	ton	37.00	...
Barium hydrate ($Ba(OH)_2$)	lb.	.049	.05½
Barium nitrate ($Ba(NO_3)_2$)	lb.	...	.07¾
Barium selenite ($BaSeO_3$)	lb.	...	1.50-1.75
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash	lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.022	.0245-.027
Powdered	In bags, lb.	.0245	.027-.0295
Boric acid (H_3BO_3) granulated	In bags, lb.	.05	.0525-.055
Cadmium sulphide (CdS)—	lb.	...	.90-.95
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Chromite	lb.	...	.0215
Cerium hydrate			
100 lb. drums and 600 lb. barrels	lb.	...	.65
Chrome Oxide Green, 400 lb. bbls.	lb.	.17	.215-.25
Cobalt oxide (Co_2O_3)			
In bbls.	lb	...	1.39
In 10 lb. tins	lb.	...	1.49
Copper oxide			
Red (Cu_2O)	lb.	...	.25
Black (CuO)	lb.	...	.15
Black prepared	lb.	...	.22
Cryolite ($Na_3Al F_6$) Natural Greenland			
(Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	.08½	.09
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	...	2.30
Feldspar—			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	30.50	...
In bags	ton	32.10	38.00-40.60
Formaldehyde, bbls.	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	...	.0425
Black ($Fe3O_4$)	lb.	.04½	...
Iron chromate	lb.	...	.035-.05
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	...	.16
Lead oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.07	...
In 5 Ton lots	lb.	...	.075
Less than 5 Tons	lb.	...	.08

		Carlots	Less Carlots
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	...
Burnt (CaO) ground, in bulk	ton	7.00	...
Burnt, ground, in paper sacks	ton	9.00	...
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.25	2.25
Limestone ($CaCO_3$)	ton	1.75	...
Litharge (PbO) (New York Prices)	lb.	.06	...
In 5 Ton lots	lb.	...	.065
Less than 5 Tons	lb.	...	.07
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08-.09
Magnesium sulphate (U.S.P.)	lb.	...	.0265
Manganese, Black Oxide			
In Paper bags	ton	50.00	52.50-55.00
In Burlap bags	ton	51.50	54.00-56.50
In Casks	ton	53.00	55.50-58.00
Neodymidm oxalate, 50 lb. drums	lb.	...	5.00
Nickel oxide (Ni_2O_3), black	lb.	...	.35-.40
Nickel monoxide (NiO), green	lb.	...	.35-.40
Plaster of Paris, bags	ton	31.00	23.00 29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	...	.09
Powdered	lb.	...	.09½
Potassium carbonate			
Calcined (K_2CO_3) 96-98%	lb.	.06⅞	.07⅜
Hydrated 80-85%	lb.	.06	.06¼-.06⅜
Potassium chromate (K_2CrO_4) 450 lb. bbls.	lb.	...	.16
Potassium hydrate (KOH) (caustic potash)	lb.	.06¼-.06½	.08-.08½
Potassium nitrate (KNO_3) (gran.)	lb.	...	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	...	.19
Powder blue	lb.	...	.20
Rare earth hydrate			
100 lb. drums	lb.	...	.35
325 lb. barrels	lb.	...	.30
Rochelle salts, bbls.	lb.	...	.12½
Rouge	lb.	...	Po. or Gr. .13½ / Cry.
Rutile (TiO_2) powdered, 95%	lb.	.10-.12	.13-.15
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	27.00
Selenium (Se) In 100 lb. lots	lb.	...	2.00
In lesser quantities	lb.	...	2.10
Silver nitrate ($AgNO_3$) . (100 oz. bot.)	per oz.	...	.39
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	1.10	...
In barrels	Per 100 lb.	1.50	...
In bags	Per 100 lb.	1.25	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.07
Sodium chromate ($Na_2CrO_4 10H_2O$)	lb.	...	.08⅜
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05¼
Sodium hydrate (NaOH) (caustic soda)			
Flake	Per 100 lb.	3.00	...
Solid	Per 100 lb.	2.60	...
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	Per 100 lb.	...	2.00-2.25
95% and 97%			
Bulk	Per 100 lb.	1.175	...
200 lb bags		1.24	1.29
100 lb. bags		1.275	1.325
Sodium selenite (Na_2SeO_3)	lb.	..	1.80-2.00
Sodium uranate (Na_2UO_4) Orange	lb.	...	1.50 1.55
Yellow	lb.	...	1.50-1.55
Sodium uranyl carbonate	lb.	...	.80-.90
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Tin chloride ($SnCl_2$) (crystals) . in bbls.	lb.	...	.38
Tin oxide (SnO_2) in bbls.	lb.	...	.53
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	3.00
Yellow orange	lb.	...	1.50
Zinc oxide (ZnO)			
American process, Bags	lb.	.05	.05¼
White Seal, 150 lb. bbls.	lb.	.06¾	.07
Green Seal bags	lb.	.06	.06¾
Red Seal, bags	lb.	.05½	.05¾
Zircon			
Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude. Gran. (Milled .005-.02c higher)		.03½	.04-.05

GLASS CONTAINER WORLD TRADE

(continued from page 385)

CZECHOSLOVAK EXPORTS SHOW LARGE DECLINE

Czechoslovakia, an important manufacturer of glass containers, reported an increase in exports during 1934 over 1933. Reports for the first six months of 1935, however, indicate a decrease from the figures for the same period of 1934. Outward shipments for 1934 were valued at 17,779,000 crowns, and for the first six months of 1935 at 6,368,000 crowns compared to 10,196,100 crowns for the same period of 1934. Detailed statistics for these periods are not available, but the following table of 1933 exports indicates important Czechoslovak markets abroad.

Czechoslovak Exports of Bottles—1933

Country of Destination	1000 Crowns
Netherlands	3,543
Belgium	2,207
Switzerland	2,148
Union of South Africa	1,333
Italy	1,080
Austria	757
Great Britain	539
Turkey	786
Denmark	438
French Morocco	454
United States	427
Germany	298
Egypt	277
Cuba	55
Canada	12
Others	3,145
TOTAL	17,499

In only one of the leading foreign markets of the United States (the Union of South Africa) does Czechoslovakia compete to any great extent. Her exports to Canada and Cuba are of little importance. It is significant, on the other hand, that the four leading German export markets—Netherlands, Belgium, Switzerland and Union of South Africa—are also listed as leading Czechoslovak markets.

NETHERLANDS TRADE DECREASED

The Dutch foreign trade in glass containers declined during 1934. Imports dropped from 1,980,000 Florins in 1933 to 1,433,000 Florins in 1934. Exports, likewise, decreased in value from 422,000 Florins in 1933 to 414,000 Florins in 1934. While detailed statistics on this trade for 1934 are not available, previous statistics indicate Great Britain, Palestine, Union of South Africa, British West Africa, Turkey and French Morocco are the leading export markets. Germany, Czechoslovakia, and Belgium are the leading import sources. The statistics quoted include glass bottles, demijohns and carboys.

The Netherlands bottle making industry has lost much of its former importance. In 1910, there were sixteen bottle manufacturers in the country, compared to the five plants in active operation today. The cause of this decline has been traced to the loss of export markets and foreign competition in the domestic market. The domestic use of glass has increased steadily and during the last few years the national breweries have been pushing the sale of bottled beer, while retail consumption of milk and several other foodstuffs in glass containers is constantly expanding. This domestic trend is the most encouraging development in the industry at present.

BELGIAN FOREIGN TRADE IN BOTTLES EXPANDING

Following the general trend of world trade in glass containers during 1934, Belgium increased both its imports and exports. Although the least important among the leading countries in this trade, Belgium's 1934 exports were valued at 5,991,000 francs and her imports, 4,172,000 francs, the latter figure representing a slight increase over the 1933 total of 3,933,000 francs. There are listed below the leading markets for Belgian glass containers during the last two years:

Belgian Exports of Bottles

Country of Destination	1933 1,000 Fr.	1934 1,000 Fr.
Netherlands	1,157	1,188
United Kingdom	1,044	1,049
Morocco	554	728
Tunis	275	98
Turkey	274	519
France	263	23
Egypt	189	273
Canary Islands	166	132
Germany	81	81
Denmark	78	44
Cuba	54	54
Malta	16	251
Others	746	1,551
TOTAL	4,897	5,991

Ordinary bottles of from 25 centiliters to 12 liters are the most important exports, accounting for over 90 per cent of the total. Demijohns encased in metals and other substances are also important items in this trade.

Although there is little information available concerning the Belgian glass container trade, it is doubted whether the industry will soon regain its previous prosperity. New plants created in foreign countries to circumvent trade obstacles appear to be maintaining their positions. There was recently instituted a license system for imports of bottles in an effort to assist container producers.

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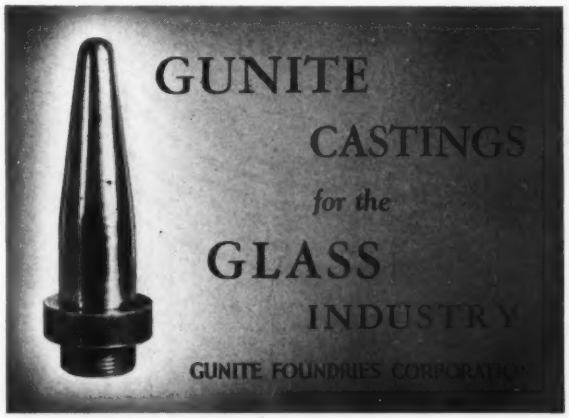

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Copper Carbonate
Copper Oxides
Glass Decolorizers
Iron Chromate
Iron Oxides
Iron Sulphide
Lead Chromates
Lepidolite
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Neodymium Oxalate
Nickel Carbonate
Nickel Oxides
Nickel Sulphate
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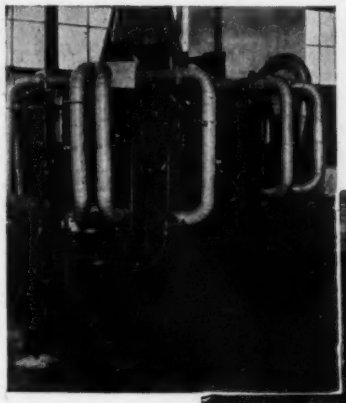

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